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British Foundrymen's Association (London Branch).—Lecture by Dr. W. Rosenhain, B.A., D.Sc. (National Physicial Laboratory).

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British Foundrymen's Association (Halifax Branch).—"Mishaps and Recoveries: A Practical Paper," by J. Gaunt.

British Foundrymen's Association (Scottish Branch).—"Up-to-date Practice in Iron Founding," by G. Watt.

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British Foundrymen's Association (Sheffield Branch).—"Steel Castings," by Hy. Brearley.

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British Foundrymen's Association (Newcastle-on-Tyne Branch).—"Everyday Difficulties in the Foundry," by E. Smith.

NOTES AND COMMENTS.

The Problem of Labour Supply.

A curious side-light is thrown on the question of the foundry's labour supply, by a Paper recently presented before the Pittsburg Foundrymen's Association, in which the author dealt with "The Menace of Scarcity in Common Labour." The statements, of course, refer to American industries, but they have also some bearing on our own affairs. Nearly all foundries, it was contended, and in fact all industries requiring unskilled labour and that cannot supply nice, easy jobs, were experiencing much difficulty in obtaining and holding common labour. The scarcity had caused many hardships and excessive costs to manufacturers, which, for the time at least, could not always be charged to the consumers. Production had been retarded, and some important and proposed enterprises had been abandoned. It was also pointed out by the author of the Paper that the scarcity of common labourers' would help to shorten periods of business prosperity. The coming winter would naturally see a greater supply of labourers for indoor work, but if the present prosperity continued until next spring, foundries, mills and furnaces would again be hunting for men, and it was a question whether the increased wages would fill the demand. The great trouble was that a search for something nice and easy constituted the principal aim of many workmen. Fully 50 per cent. of the men the author had approached rejected foundry work flatly because it was not clean and easy. The question of wages was seemingly of secondary consideration. "There are so many nice, easy vocations for the employment of unskilled men that when prosperity prevails, the easy jobs draw and hold men who refuse to go into foundries, furnaces and mills. When unskilled men fail to get nice, easy jobs, they often resort to loitering or crime."

As the expressions of a troubled foundry employer the foregoing may pass without much comment; but as a pronouncement on an important topic made before a technical society, these remarks convey a curious sense of ill-logic. True it is that labour for hard and dirty work is scarce, and that the nice, easy job appeals to most men. But there is always in operation that inevitable factor, the law of supply and demand. The so-called easy job is very soon over-stocked and the payment falls until automatically it ceases to become extraordinarily attractive. There are, of course, fluctuations in the relationship between value and pay in all classes of employment, but they automatically adjust themselves in a comparatively short time. In considering the labour question in America, many writers are apt to overlook a number of the essential factors. The country's industries are growing, and have been built up largely on foreign labour for the rougher and more laborious classes of work; and there is a tendency for the American labour proper to drift to the cleaner and

"more refined" jobs. The supply of the rougher class of labour, being drawn from outside, is frequently subject to shortage from a number of causes, as, for example, the recent Turko-Italian war, which has denuded the United States of a very large number of workers who have gone home to Italy, and also the present European conflict, which is checking the tide of emigration. Further, American industries, particularly the iron and steel industry, are subject to what we may fairly term artificial control. Business booms are frequently merely engineered movements, not always based on solid increased demand, with the result that production is unduly stimulated at times, with corresponding reactions following. The States' iron trade at the moment is experiencing a period of exceptional activity, in so far as works are operating under a great pressure, but it is the opinion of some reliable people that the pressure is largely artificial. This is far more readily possible in that country than here, owing to the somewhat curious practices that exist between maker and buyer in the matter of ordering and accepting delivery of iron and steel manufactures. This may seem rather wide of the subject, but the point is that causes that scarcely are acknowledged are operating to cause a scarcity of labour of the poorest class, while the demand is rather abnormal.

As regards the liking for a nice, easy job, it must be acknowledged that the supply of men who lack entirely an appreciation of the differences between conditions of employment in different directions is decreasing. It is impossible to attempt to train men to a higher level of work, in keeping with modern requirements, and at the same time keep the blinkers on them regarding the conditions of their work compared to other classes of work. It is the price paid in relation to requirements of intelligence and training and to conditions of employment that governs the supply, and if bad or arduous conditions accompany a low or even average wage, the supply will be poor, and poorer as the general understanding of the workers enlarges.

The Playground and Labour Supply.

Reverting to the author of the Paper abovementioned, he condemns the playgrounds and gymnasiums, which, he says, educate for a continuation of amusements rather than for hard work. He also severely criticises various measures for the promotion of health, which, he claims, are being carried to a ridiculous extent. "Labourers," he states, "can be found carrying their own sanitary drinking cups and wearing gloves when working, lest they might soil their hands." Personally, we hold the opinion that the gymnasium and the playground perform a valuable function in our industries, in keeping men fit and capable, and relieving the drudgery of many classes of work. There is some other unmentioned factor in the case if the effect on the American workman is bad. As regards the other point, why should any class of man be denied what refinements he chooses, if they do not prevent him performing his work properly. From first-hand descriptions of many foundries in both America and this country, there is room for some improvement, if only in the interests of the existence of the men.

Continuing his complaints, the author of the Paper deplored the tendency of many men having ability to be nothing more than common labourers, to avoid and be ashamed of work that begrimes. There was, he said, but one course left for all employing agencies; there must be a high wage rate for those willing to do the hard, dirty work of life, while those who desired the nice and clean, easy work, would have to accept the low wages. Exactly; but, as beforementioned, this state of affairs will be produced automatically. The fault in the whole contention is that the author does not realise that the trouble at the moment is due to rather abnormal conditions—exceptionally rapid growth of the industries; large but irregular inflow of foreign labour to develop the immense resources of a country with a small native population; and more or less speculative fluctuations in business activity such as are almost inevitably associated with the rapid rise of any industry. We have in Great Britain a scarcity of efficient foundry labour, but that is a very different thing and due to other causes than those operating in America. That subject, however, is dealt with on another page, under the title of "Education in Relation to the Status of the Foundry."

Such pronouncements as that quoted above are regrettable, for while they are ill-based, they appear at first glance to be sufficiently founded on fact to be eagerly seized upon by opponents of improved working conditions both in this country and abroad. So far as measures for the promotion of health are concerned, though American experience may show that such measures are carried to extremes, in this country that point has not yet been reached. No doubt there have been many hasty and ill-advised regulations imposed from time to time; but in the engineering and foundry trades, it is held by many employers whose opinion we have taken that the healthier the working conditions and the better the sanitary arrangements supplied for the men, the better is the work done, from the standpoint of both quality and economy. There may be cited individual cases which appear to refute this, but as a general principle we believe it is quite correct.

The Coke Question.

In the course of a discussion which took place before the Lancashire Branch of the British Foundrymen's Association last month, and reported on another page of this issue, exception was taken to the comment we published, in our issue of July last, on a previous discussion on the subject. We remarked on the futility of a dicussion which isolated one property and disregarded the other variations which might occur, and mentioned incidentally that a light coke may be high in carbon and of good strength, making it very suitable coke for the cupola, or it may be hopelessly weak and high in ash, the same applying also to heavy coke as such. Criticising our comment, Mr. Harrison, last month, remarked that carbon had nothing to do with the density of the coke. That, we may state, was the very point which we stressed, viz., that either a good or bad coke, from the standpoint of strength and composition, might be heavy, and that, therefore, the weight of itself had no significance except when taken in conjunction with other properties. The weight of a coke is a function of its porosity, but the same weight for a given bulk may be got with two quite distinct cell structures. It is the total pore space in a given bulk which determines the weight, but that pore space may be obtained with a strong or a weak structure. A fine but regular structure may give nearly as much actual pore space as an open and irregular structure. It is by no means clear what is generally understood as "weight" and "density" when discussing cokes—the two terms are often confused, although the former refers to weight in relation to bulk, and the other to pore structure.

We still contend that there is little real good to be got by sectional discussion of such questions; by the consideration of one factor without defining the limits of variation in the associated factors. Obvi-

ously, from the experiences quoted by different authorities, heaviness or lightness alone does not constitute a qualification. Mr. R. Buchanan is quoted as preferring a heavy coke, and Mr. F. J. Cook a light coke. The opinions expressed at last month's meeting also varied according to individual experience; nor could it be otherwise, since the accompanying factors which make for suitability vary in almost every foundry. For this reason we cannot agree with the Chairman in ruling out the question of light *v.* heavy charging in connection with the subject under discussion. It is, of course, advisable in any discussion to keep to the term of reference; but the isolation of one point, such as that of density, when other factors such as the depth or weight of charge have an important bearing on the subject, tends to barren discussion. Since different foundrymen have distinct preferences in the matter, and are each getting good results, it becomes necessary to ascertain from each, before pronouncing judgment, (1) the relative density, composition, pore structure and strength of coke used, (2) the weight of charges and class of iron, and (3) the blast pressure and amount of air delivered into the cupola. It would probably be found that in good practice factors (2) and (3) vary considerably according to the density of the coke, and that the question does not resolve itself into one of denseness or lightness but of the ratio of factors (1), (2) and (3) to each other.

The discussion before the Lancashire Branch, however, appears to give the valuable indication that in the general run of foundries the best results are obtained with the lighter rather than the heavier cokes. As regards the point of economy in amount charged favouring the light coke (on the basis that more charges of a given bulk can be got from a ton of light coke than from a ton of heavier), we fail to see that there is much in that, if the coke is charged in its correct proportion in relation to the metal. As Mr. Penlington aptly pointed out, whether the coke is charged by bulk or by weight, unless it is charged in a correct ratio to the charges of iron and the blast pressure, correct melting will not be got. Whether charged by bulk or by weight the charges have to be proportioned in the cupola in such a manner as to get correct melting. If the charges, air pressure and volume, are correctly proportioned so that the heating value of the coke is properly utilised, the question of economy turns on the carbon content of the coke. But this brings in the question of the excessive formation of carbon-monoxide, which involves a waste of heating value. This factor varies with the density of the fuel if other conditions are stable, and therefore under any given conditions the density of the coke has a distinct significance—but only under those conditons, for by an alteration in, say, the weight of charges and the blast pressure, the whole relationship is changed. As we have on previous occasions pointed out, there is, undoubtedly, a fairly wide range within which cokes may vary and still be made to give good melting results: but there is also a definite, although as yet undetermined, density and pore structure which gives the best results under specific conditions, and it is probably the fact that conditions and methods of operating furnaces vary considerably that prevents the ready arrival at a definite conclusion on the matter.

It would appear quite feasible that with heavy charges of coke, say 12 in. and over, a dense coke would be the more economical. But here again the cell structure must be taken into account, as affecting the surface offered for combustion, and also the air volume and pressure of blast must be considered.

The one fact which does stand prominent in the discussions which take place on this subject is that both heavy and light cokes may give good results under different condition, and the conditions require adjusting to obtain the best from either. The experiences quoted, further, appear to support the contention, which is steadily gaining ground, that for practically all conditions and with all varieties of coke the charges of both iron and fuel should be lighter than is frequently the practice. We do not presume to utter any dictum on the virtues of heavy and light cokes respectively, for the simple reason we do not consider the case can be so summed up. We merely wish to point out that in discussing the qualications of a foundry coke it is futile to confine attention to one quality alone. A far more useful purpose would be served by enquiring as to the conditions which make for success with a coke of a certain description. Nor must it be supposed that we are particularly criticising the results of the discussion at the Lancashire Branch. It at least elicited some useful information as to individual preferences based on actual experience. The defects which we have here pointed out are common to all such discussions, so much so that only expressions of individual preferences are generally the result. To get much nearer it will be necessary to collect extensive data as to the numerous variable conditions under which individual foundrymen find they get the best results with different classes of coke. An analysis of these data would probably afford a much better aid to deciding a vexed problem.

Monel Metal in Steel.

Investigations conducted by Dr. C. F. Burgess, at the University of Wisconsin, have led to considering the possibility of the use of the natural copper-nickel alloy, known as "monel metal," as an effective alloy for iron and steel. About 75 per cent. of the world's supply of nickel comes from the Sudbury district of Ontario, Canada, where the nickel occurs as a sulphide (pentlandite) associated with phyrrotite and chalcopyrite. The resulting product is first a matte of about 80 per cent. combined nickel and copper content, which by expensive treatment, is refined to nickel and copper. The nickel is then combined with iron to make ferro-nickel for the making of nickel steel. To use the "monel metal" as an addition to steel would save the large cost of refining the nickel from the natural combination with copper. The usual content ratio for "monel metal" is 66 to 67 per cent. nickel, 24 to 26 per cent. copper, upwards of 0.05 per cent. iron and about 2 per cent. manganese. Dr. Burgess' tests, using electrolytic iron to combine with, were conducted with an artificial mixture of nickel and copper conforming practically to the monel mental proportions—that is, nickel and copper about 3 to 1 respectively. The tests covered the range from 2 to 6 per cent. nickel and copper in the ratio mentioned. Concerning the results, Dr. Burgess says:—"The effect of the double addition of nickel and copper is most striking. In all but one or two instances the values for the ternary alloy exceed those for either binary series, at both the elastic limit and the ultimate stress; and the effect is even more marked after the annealing of the bars. In fact, one might almost treat the copper as so much added nickel, and compare bars on the basis of a certain nickel content on the one hand, against an equal quality of nickel plus copper in the ternary alloy; and even this will not do for the higher percentages of the nickel-copper-iron alloys since, especially for the annealed bars, the strength of the ternary alloys is very markedly greater than any of the binary series. These high strength values are reached with practically no diminution of ductility, as is indicated by comparison of the figures for elongation and reduction of area."

Education in Relation to the Status of the Foundry.

By Alexander Hayes.

Before the London Branch of the British Foundrymen's Association in November 8, a Paper on "Education in Relation to the Status of the Foundry" was presented by Mr. Alexander Hayes, an interesting discussion following. The author prefaced his Paper by remarking that though the question was approached from the foundry standpoint, it constituted the ever-growing problem of all our national industries. Since the foundry trade, owing to the nature of its work and conditions, was one of the first to be affected by a decline in the standard of workmanship, it might be taken as a barometer indicating the way in which other trades would eventually be affected. But it was not to be thought that the education question was exclusively the foundry's problem; it was the problem of the future industrial prestige of the nation. The Paper was as follows:—

The present status of the foundry in relation to the industries of the country, and particularly the engineering industry, offers problems of such importance and diversity that only sectional discussion of the subject is possible in such a meeting as this. In order, however, to narrow the field, and concentrate attention upon the phases which fall within the legitimate realm of the British Foundrymen's Association, the writer will give a very brief survey of some of the causes which have led up to the present position. Having indicated the influences at work, it will be a somewhat simpler matter to concentrate on the possible means of producing a definite movement in the direction of improvement of the foundry's status.

With the foregoing in view, it is proposed to deal directly with the following three questions:—

(1) Why the class of youthful intelligence attracted to the foundry has for years tended to remain stationary or even deteriorate, while other branches of the arts have secured a steady improvement in their apprentices?

(2) Why the foundry is held in poor esteem by many other branches of engineering?

(3) In what way improved education offers a solution to the two foregoing difficulties, and what system of education suggests itself as being best suited to the improvement of the status of the foundry trade?

Historical Retrospect.

The last century or so has witnessed a distinct revolution in the conditions under which our national industries are conducted, the outstanding feature of the change being that the factory system, *i.e.*, the system of producing under organised and specialised conditions, has taken the place of the old system in which small master-men controlled small establishments and acted as personal instructors to their young and inexperienced employés. The principle of the division of labour, by being carried to this extreme, has militated against the development of the rank and file workers, since only sufficient intelligence to carry out routine and easily-learned operations is demanded. Specialisation in production has many advantages when carried to a certain point, and is even an absolute necessity for the development of civilisation; but it tends to restrict and even destroy the adaptability of labour, by confining the wage-earning capacity of the worker to a single operation. In absolutely stable industrial conditions, or even conditions of absolutely steady progress, this feature would not become so noticeably objectionable as it has proved to be; but it is well understood that industrial conditions are not stable, and when individual branches of a trade and individual plants are considered, some flexibility of capacity on the part of the workers, within limits, becomes a necessity. Such flexibility in any industry can only be attained by training the intelligence of the workers beyond what is required by the specialised system of factory operation. If, then, the conditions of factory operation militate against this development of individual intelligence, either the system stands condemned or some outside influence must be brought to bear on the situation to counterbalance the restriction imposed.

The writer does not wish to imply that the revolution in industrial conditions has not been accompanied by the rise of a better and more technically competent class to meet the requirements of modern scientific methods of production; the contention is rather that modern conditions have caused practically a segregation of workers into two great classes—those who have been educated and trained to a comparatively high degree, in keeping with the demands of, for example, engineering of to-day, and those whose education and intellectual development has practically terminated with a knowledge of some few simple industrial operations of a specialised class. The old-time worker with a continually-accumulating knowledge, the acquisition of which was stimulated by the ever-varying demands of his trade (as distinct from a routine operation of a selected branch), has largely given place to the two classes mentioned; and this is the cause of the complaint frequently made that workmen of to-day are not so competent as formerly. Actually they are more competent in the aggregate, but individually the larger portion are less so, while the minority are frequently highly qualified.

The Effect of Factory Conditions.

While these conditions may, and, in fact, do, operate successfully in large establishments where a minority of highly-skilled labour can organise and control the operations of a mass of routine workers, there are many reasons why a higher intelligence in the latter is desirable. Apart from the necessity for flexibility of earning capability which is demanded by trade fluctuations and industrial changes, there are very many industries which have to depend largely on operatives with general and varied qualifications within the limits of their trade; but the ever-increasing segregation before-mentioned is steadily denuding those trades of the supply of such men, and instead recourse must be had to one of the two classes produced by the factory system. This, as a natural consequence, resolves itself into the lower class being employed for what it is worth, as the highly trained scientific worker is not suitable material to fill the place of the old craftsman.

The foundry trade, owing to the nature of its work—a class of work combining numerous uncongenial occupations with others requiring considerable intelligence and skill—inevitably suffers from the segregation referred to. The control of certain of the more scientific and technical sides of the work falls to highly-trained men, while the general run of the

work passes to the lower grade. This, as before indicated, meets the requirements of those foundries which, on account of the work done, can operate on the factory principle; but the effect is detrimental to the other and larger proportion of plants whose requirements can only be properly met by the competent craftsman.

It must not, be it noted, be taken that this latter class is extinct—to assert that would be to court blank refutation by some of the work turned out daily from our foundries; but it is the gradual reduction of that class which constitutes the foundry's problem to-day. Nor can it be denied that the competent craftsman still predominates in various other branches of the arts. Why the same intelligences are not drawn to the foundry is best answered by a consideration of the second question of why the foundry is held in poor esteem.

The answer to this has already been generally indicated in the foregoing, in that a good proportion of the work of a foundry can be quickly learned by boys, who acquire sufficient dexterity by practice to continue on similar routine operations when they become men. In many establishments much of the work can be so divided that only a proportion of employés need be more than unskilled men, all really skilled work being given into the hands of the more intelligent and better experienced men.

But another potent fact is the poor understanding on the part of users and producers alike of the nature of foundry products, of the importance of the foundry in relation to its allied industries. The engineer admits the higher requirements as regards material which his advances have made, but he does not acknowledge the higher skill and more exact methods which are necessitated in the foundry. Generally speaking, the moulder to him is still the "sand rat," a creature without much intelligence, who only requires to be given an order to ram some sand round a pattern and pour a quantity of molten metal into the impression thus made. Under the conditions of a few years ago, foundry procedure was based more on "rule-of-thumb" than established technical principles which could be expressed in print and be made the subject of instructions on the same lines as other branches of engineering; and even to-day the "rule-of-thumb" man is the backbone of the foundry doing any considerable variety of work. An examination of most foundry instruction books will exemplify this, for they are scarcely intelligible to those who have not already acquired by actual contact with the work a certain broad knowledge of procedure.

Further, procedure even for standard products has seldom been standardised, each man working out his own more or less imperfect methods. So much of the work being of that nature which allows of a passable product being produced by more or less clumsy methods, there is no great premium placed upon the man who can conceive the best method for each job. There is not the same absolute necessity for each product being of the best class as obtains in mechanical engineering. Further, the foundry's operations are not generally conducted before the notice of the public, who only witness the somewhat begrimed appearance often retained by the men on leaving their work. The engineer, too, on his occasional visits to the foundry, is often more impressed by the uncongenial conditions than by the technical skill represented. Accordingly, the possibilities for the exercise of intelligence in the foundry cannot readily be appreciated by an outsider.

Here we have, at least, a partial answer to the first question propounded. For in the education which is given to boys in our elementary schools, the only definite impression regarding the iron-making and iron-working trade they receive is that it is an extremely hot, arduous, and dirty occupation. The conditions in other trades are better understood by the youngster at school, for he frequently gets into touch with them; and since they are within his comprehension and foundry conditions are not, he fights shy of the latter.

As a further cause of the foundry's disrepute, the establishment of factory conditions, as already pointed out, tends to lower the grade of worker employed for a large proportion of the work; and it is inevitable that this must adversely affect the esteem in which the trade is held.

The writer's answer to the first question then, is that the requirements and possibilities of the foundry trade are not generally understood or made known; that there has been little of the organised movement that has characterised some other callings towards counterbalancing the deteriorating influences of factory conditions by encouraging the continuance of mental development during the early working years; that the age at which boys are admitted into the foundry, the uncongenial occupations and long hours during the early stages of the work, do not allow fair mental development of the boys entering the trade.

To the second question the answer is that lack of knowledge of the requirements for first-class foundry work, coupled with the poor intelligence of a fairly large proportion of the workers engaged, is responsible.

Education as a Remedy.

It should be apparent, if the foregoing is admitted, that education of foundry apprentices on systematic lines offers a solution in part to the problem. Coming, then to education as a remedy, it will be well to define what is meant by the word in its present application; for if the word is taken merely as attendance at school for indiscriminate cramming with dull abstract facts, the writer does not accept it as offering any solution. From its derivation education implies "leading forth." Hence, as at present used, education is the leading forth, development, cultivation, strengthening, and discipline of the mental faculties. Obviously, from this, education may be very wide and general, or confined to one or more mental faculties. Education for any particular calling is essentially concerned with those faculties which most directly bear on the requirements of the calling..

In keeping with most of the mechanical trades, the foundry trade demands the development of constructive ability, observation, and the logical faculties—constructive ability that correct methods of procedure may be conceived and materials rightly applied; observation, that the occurrences and phenomena of every-day practice may be noted and recorded for future use; and the logical faculties that cause may be deduced from effect, and procedure be based on established principles. The question to be considered is, what system of education is best adapted to aid the development of these faculties. The writer at once comes into conflict with the existing system of primary education because it is based not upon the principle of engendering the habit of acquiring knowledge for the interest it holds, but upon the idea that facts—bald, unintelligible, abstract statements of inconsequential matters—if crammed upon the memory of the child will educate him. There is little endeavour made to inculcate the principles or reasons governing, say, language construction, arithmetic, physical science and so forth. The child's mind is not taught to base procedure upon reason, but upon bald and often complicated rules. It is true that a certain amount of cramming with such rules is essential in imparting knowledge to any unformed intelligence; but if

that process is necessary up to the age of 14, then the child is not ready to leave school, for his reasoning faculties have not been properly trained to develop without guidance and instruction.

The writer considers that the years between 12 and 18 are the really crucial ones in the education of any boy. Prior to the age of 12 he has more or less imbibed ideas and associated them; but after that point he might well be given instruction in causes as well as effects, and be taught to know the "why" of things. Accordingly, the instruction in the last two years of schooling should teach him the elementary principles of mathematics, social economics, inorganic chemistry, and the fundamental principles of the English system of Law. These subjects, however, should first be taught in relation to their underlying principles; their application, if necessary, need not be treated to any great extent. At present school instruction carefully avoids explaining the principles—the "why" of the process—and trifles only with the application of a science in minor directions which are practically unintelligible. Tell the boy the basis principles and he will later apply them if he requires them, and seek of his own accord for elaboration of the knowledge imparted. Moreover, much which he encounters day by day and in general reading will become possessed of a meaning to him, whereas now he disregards it as being beyond his orbit of comprehension. This procedure in schooling would soon sort out those capable of mental development from those inherently incapable.

Although the school years as at present recognised might be far better utilised for educational purposes proper, the writer also contends that schooling should not end at the point of entering a trade or calling. The boy is still in the crucial period, and his education should be continued on selected lines relative to his chosen occupation. It should be compulsory on the part of all employers to allow suitable time (variable according to the trade) for this specialised instruction, and the existing compulsory attendance on the part of the boy should be extended as necessary to cover the period in question. Such a scheme, of course, would have to be national to be effective. Since the fundamental weakness of the present system lies in allowing the old-time education at the hands of the master craftsman to fall into disuse without supplying a substitute, and since also, the foundry's problem is inextricably linked with similar problems in other industries, a national reform appears to be the only ultimate solution.

The somewhat radical reforms suggested in the foregoing are unfortunately not within sight; so consideration may be given to other palliatives if not remedies. The British Foundrymen's Association might institute a system of periodical examinations for foundry lads and apprentices, the passing of which would secure a diploma. These examinations could be graded, success at the final examination to carry with it a special membership grade in the Association, which could be of distinction and value to the foundryman and a recommendation in seeking employment.

An organised movement might be instituted amongst foundry employers to encourage their apprentices and youths towards educational advancement and to provide facilities where possible for the same end. A body of employers who were agreed on the matter would form a strong circle which would attract other employers to it. The question of allowing time for apprentices to study during working hours raises so many contentious points that the writer has purposely avoided enlarging on it at the present time. Mr. Horne has already shown, in a Paper before the Cardiff Convention of this Association, what is being done by individual firms in other countries. But, as the writer has previously pointed out, individual firms attempting to initiate a movement in this direction have to bear considerable expense, and under highly-competitive conditions firms who rely largely on that class of labour would stand a great risk of extinction, should they set out to eliminate at once that which is unskilled, uneducated and low-paid. These are some of the difficulties which operate against spontaneous movements towards education; and for this reason it is far easier to conceive a reform in education and technical training on a national basis than applying to only one particular branch, or individual firm. That such a scheme is economically sound, the writer is convinced, but to raise the economic issues at this juncture might confuse those already placed before you.

Discussion.

Mr. J. W. Horne, B.Sc. (Branch President), in opening the discussion, said he agreed with everything put forward in the Paper. Despite the millions of money that were yearly spent on education, there was little actual benefit derived, and the money was very largely wasted. The essential requirement in an educational system was the fitting of the boy for a vocation.

Mr. R. Woods criticised the insistence on technical education for boys in the foundry on the grounds that it was not feasible in present circumstances. It was well known that a moulder in the brass foundry could seldom be got to put his own sons to the trade, owing to the unhealthy, dirty, and extremely arduous work. When a day's work in the brass foundry was finished the boy was not usually in a physical condition to take up technical or any other studies at classes. At the bottom of the question was the financial consideration; the boys were paid for their output, and few would consent to any institution which interfered with that. In the time they had at liberty, also, sport was more attractive than study. The conditions in the iron foundry were somewhat better, as the work was not generally so hard. Mechanical appliances were more in vogue for lifting, whereas the brass moulder had to lift and throw over everything with his arms. He (the speaker) considered that the introduction of machinery had lowered the status of the foundry by eliminating much of the skilled work and increasing the rate of production.

Mr. A. Willis, speaking as a brass founder, agreed that ignorance of the requirements of the trade was largely responsible for the low status of the foundry. That department had to deal with so many things beyond the ken of the manager or the engineer, that its importance was not appreciated. Further, the foundryman had been badly neglected by the technical education authorities. He (the speaker) had sought for suitable courses of instruction, and had tried inorganic chemistry first, but found that the course was not at all adapted to his needs—it did not give him the information he wanted about the metals he had to handle day by day. The founder needed chemistry, but he also needed practical metallurgy in conjunction with it. Regarding the training of boys, he thought it desirable for the boy to choose his vocation at about the age of 12, so that the last couple of years could be devoted to special study for that vocation. He agreed with compulsory attendance after the full-time school years, but the special training should start before leaving school. He commented on the low pay of apprentices, and suggested that scholarship boys should be paid more than others. The use of boys in the foundry merely as a source of cheap labour discouraged them. He also agreed that the majority of text books were not intelligible

to those who had not a broad knowledge of foundry experience; but he also found that most foundry books were not intelligible to even the foundryman.

Mr. D. Gordon (L.C.C. School of Engineering and Navigation) said that the failure of technical education lay largely with the examining bodies. A foundryman could not sit for an examination in his work alone, while the same applied to pattern-makers. They could only take the mechamcal engineering course, with foundry work as the second part. He (the speaker) also criticised the nature of the competitions organised by the Founders' Company, who gave prizes for designs and castings of medallions and such like work, but ignored practical founding. In regard to the attendance of boys at classes, he found that out of a class of 20, at least 50 per cent. were from the foundry. Commencing on the "sandwich" system, *i.e.*, the system of half-time at work and half-time at study, he considered it was detrimental to the interests of the small employer, who was largely dependent on his apprentice labour to compete with big concerns. He considered that the system made for the development of trusts and big commercial combinations. The lecturer, in remarks supplementary to the Paper, had referred to the fact that in Germany the system of vocational education during apprenticeship was compulsory and satisfactory in operation. But he (Mr. Gordon) contended that conditions were different in Germany, where a class of discipline different to what the English worker would stand was in vogue. Acceptance of compulsory schooling in Germany was also more readily accepted, as it was a means of curtailing the military service.

Mr. Slater remarked that the foundry trade was most deceptive to the outsider. The large number of special requirements for good work were not understood or even perceptible to those not intimately connected with the trade. He considered that technical training would never be solved until it was made a national affair, and placed under the control of the Government Education Authorities. The interests of the boy and his employer were not identical, and except under proper control and organisation training was not likely to be carried on satisfactorily. He awaited the day when the British Foundrymen's Association should form classes, and use its influence to induce the authorities to educate the boys entering all industries.

Mr. J. Oswald (Past-President of the Branch) related his own experience with apprentices. After unsatisfactory results with the system of taking in boys to the foundry at 14 years of age, he approached a certain Trust with a view to obtaining better boys. His apprentices were now indentured until 21 years old, and were compelled to attend a Polytechnic Institution for study on two nights a week, for pattern-making and machine construction. By this system he had got a much better and more satisfactory class of boys in the foundry.

Mr. Hayes, replying to the discussion, said that he quite appreciated the points raised by Mr. Woods. But they only upheld the claim that greater attention should be given to the education and care of the boys. The economic issues raised brought in the criticism of Mr. Gordon, with which he (the speaker) could not at all agree. He denied that the "sandwich" system as suggested (not necessarily exactly half-time in all trades), would hurt the small employer who was trading legitimately, provided the system was made a national one. It was quite conceivable that an individual employer who initiated the system would be at pecuniary loss, but to place all employers on the same footing would nullify that feature.

Mr. Gordon here dissented, maintaining that the system would hurt the small employer, who was dependent on his apprentices for cheap production.

Mr. Hayes, in continuation, replied that that claim was based on the presumption that the apprentices were in the works simply as cheap labour. Therein lay the fallacy which so often obscured the question. It was of no consequence, in regard to the essential purpose of apprenticeship, whether the boy was a producer the whole time, or whether he produced nothing during his apprenticeship; the purpose of that training was to make him an adequate producer when he reached man's estate.

Mr. Gordon: But what employer is going to bear the expense of training boys for nothing?

Mr. Hayes: He does not train them for nothing; I simply state that the essential purpose of the apprenticeship is not production, but training for production. But, as all who have the handling of boys must know, the only way to teach any trade is to start the pupil operating at that trade; and in this way the pupil very soon becomes a profitable producer for his employer if he is given the right training. Should, however, the question of production be given precedence over the question of training, the purpose of the latter is very liable to be lost. The employer may profit temporarily by the boy's work, but the boy suffers ultimately, as also does the trade, through his inefficiency. It is well understood by broad-minded employers that the best way to profit by an apprentice's labour is to make him as efficient in all his work at as early a date as possible. But since this is not appreciated by many masters, who simply desire to see some return from the boy's labour at the earliest moment, the necessity for control and supervision becomes more and more essential. In large establishments, particularly, the tendency to keep the apprentices at only one branch of their work must be combated.

Continuing, the lecturer claimed that any concern which was dependent on an excess of cheap apprentice labour for its competitive capacity was operating on an unsound economic basis, and the sooner it ceased operating the better for the trade at large. There were many firms who were inclined to exploit boy labour, but their interests could not be reasonably set up against the interests of the trade and its operatives. There was a definite rule that could be taken as governing the employment of boys. The average working life of a craftsman (after apprenticeship) was, roughly, 30 years, during which time five boys could be trained for six years; therefore, with such a period of training, the ratio of boys to men should not exceed 1:5 over any considerable period. That ratio would be altered according to the length of training required in the trade, but the principle stood in all cases. He recalled that at the Cardiff Convention of the Association Mr. S. A. Gimson had contended that by the "sandwich" system there would either be only half the number of apprentices required in the foundry, or twice the number going through training, and that in the latter case they might be going far beyond the demands of the trade. This contention ignored again the vital point that apprenticeship was not in its first essential a period of productivity, but was a period of training for that end. It presumed that an essential part of the work could only be conducted by boys. That contention obviously could not stand if the criterion previously stated, regarding the purpose of apprenticeship, were accepted—and he could not see what other criterion could be accepted. True, it was that better trading facilities, and better access to cheap raw material on the part of big combinations, constituted an advantage over the small employer, and handicapped him in competitive trade; but the small employer had the counter advantage of close and intimate acquaintance with every detail of his work's operations, personal

touch with his men, and greater opportunity for economy in directions which were liable to be missed in large organisations. He could give personal encouragement to individual men, and assist each to operate to the best of his ability in a way that was impossible in a very large establishment. But too often the handicap of the small employer was that of limited business knowledge and power of organisation, coupled with out-of-date plant, which under no conditions could be made to compete with better equipped works. It was not reasonable that exploitation of boy labour (a poor subsitute at the best) should be encouraged in order to off-set this lack of business economics and this bad equipment of works, which so frequently constituted the difficulty of the small employer. Even if the purely humanitarian claims were ignored, surely the claims of national economy should be heard.

Referring to the suggestion by Mr. Willis, that the choice of vocation should be made at about 12 years of age, the lecturer continued, he did not consider that possible. In the great majority of cases a boy's capacity and inclinations could not be judged until he came into actual touch with working life, and at a maturer age than 12. If an organised system of vocational training were adopted, it would be a simple matter to re-direct the energies and education of a boy who was found to have been started in the wrong groove. The great desideratum was not to train every boy for a special class of work, but to so develop his intellect and stimulate his self-education that whatever course he took he would naturally seek to become efficient.

The other remarks on the Paper, concluded the speaker, were too much in accord with the ideas put forward to call for reply, beyond a sincere expression of pleasure at the way in which the Paper had been received.

Communicated Discussion.

Mr. Donald Wallace, of Bedford, wrote as follows :—The question of education in relation to the status of the foundry is at present, till the municipalities as a whole realise that foundrymen really require education, a question for the master, and I would like to outline the scheme which Messrs. W. H. Allen, Son & Company, Limited, Bedford, have for the education of their apprentices. I will only touch on pattern-making and foundry apprentices, though all apprentices in the Queen's Engineering Works, Bedford, pass through a course of education suitable for advancing them in their separate trades. In the first year of their apprenticeship the pattern-making and foundry apprentices with all others in the works of the same year attend an instruction class one afternoon per week, the first half of which is devoted to elementary sketching and drawing, and the second half being an elementary trades class. The drawing class aims at teaching a boy how to read a drawing, but not at making a draughtsman of him. He is also taught to make sketches so that he may be able to put his ideas on paper in such a way that other people may be able to understand them. Some part of the afternoon is devoted to machines and appliances met with in engineering shops and foundries, the use and working of these articles being explained. The different materials required in their construction and also the reasons for their use are also dealt with. Of couse, the Company's own manufactures of steam engines, turbines, pumps, etc., have a very important part in these illustrations, as a boy ought to take a more intelligent interest in making a pattern or a mould if he knows the ultimate aim in view. Workshop arithmetic is also part of the scheme, and again this is brought to bear as much as possible on the daily work. It is found that a boy takes very little interest in the mensuration of a brick wall if his daily work is with wood, sand, or iron. In the second and following years of their apprenticeship the boys are divided into separate trade classes and taught what should make them more intelligent workmen. The pattern-making apprentices are taken much further into drawing, but still with the same aim in view, to make them capable of forming a rapid and accurate idea from a drawing of what is required, and to make the pattern in such a way that the finished casting may be the best commercially. They are also taught the nature of timbers, how they should be cut, and also their value. Different classes of moulding are explained. Various ways of making different patterns are brought to their notice to help the future pattern-maker to approach his pattern from a moulder's standpoint. Workshop geometry and arithmetic have also a place, and general hints are offered which can be given better collectively than at the bench.

The foundry apprentice is also taken further into drawing, so that when his advice is required as to how a pattern should be made he will be able to give it from the drawing and not require to wait for the pattern to see what the article required really is and then grumble at the pattern-maker for making it differently from what he expected. Moulding sands, shrinkage and contraction, warping and want of balance, lifting pressures of metals, blow-holes and drawn holes, weight of gunmetal and iron castings and tensile strength of metals are all studied during the remainder of apprenticeship. Of course they are all studied with a view to making a more intelligent moulder, not to make every apprentice a foreman or a manager; but if a lad really has it in him, the introduction to the work thus given will perhaps be the means of urging him on to further study and also create a desire to solve some of the foundry problems which are met with every day. These classes are held in the Allen Institute, which was built for the use of the workmen. The boys are paid their usual wages for the time thus spent, and are allowed half an hour longer at dinner-time in which to wash and change if necessary. While every firm cannot do as Messrs. W. H. Allen have done, it is quite possible, in places where other facilities have not been afforded to educate the foundryman, for two or more masters to join hands in an endeavour to form a place for the purpose. Messrs. Allen find that practical men who are in touch with the trades every day are the men best qualified to give the instruction required. They have had outside assistance, but at present the classes are taken by five men from their own staff, under the direction of the engineering pupil's demonstrator, who was in a large measure responsible for the arrangement of the whole of this scheme of instruction.

Essay Competition by Keighley Association of Engineers.

The Council of the Keighley Association of Engineers offer two prizes for the best description of the methods of manufacturing a section or part of a machine, of which a drawing may be had on application from the Hon. Secretary, as to the idea of pattern making, moulding, preparing, and machining the same for repetition work, and accurate interchangeability, and of which sketches will be essential. The first prize is £3 3s., and the second prize £1 1s. The Council also offer prizes for the best Papers written on any subject appertaining to modern engineering, the writer having the privilege of choosing his own particular section of work, the competition being divided into two classes, seniors and juniors. Each writer must either be a member of the Association, or reside or work in the Borough of Keighley. The essays must be lodged with the Hon. Secretary, Mr. Robert Hudson, South Street, Keighley, not later than December 31, 1912.

A Large Bed-plate Casting.

The increasing size of engineering works of all descriptions has from time to time brought about a continuously increasing demand for larger or better equipment in machine shops and foundries, until the engineering shops' equipment of a decade ago would contrast very unfavourably with that of modern engineering establishments of large size. Taking the case of foundry practice only, the castings which can now be produced are colossal compared with those of a few years ago, and this is notably the case in connection with the main portions of the large-capacity steam engines which are now being manufactured for electric power production purposes, colliery winding and ventilating equipments, iron and steel works blowing plant, etc.

Probably one of the largest single castings which has ever been produced and which has been turned out of the shops of the Mesta Machine Company, at West Homestead, Pennsylvania (U.S.A.), is illustrated herewith. Fig 1 shows the operation of casting this bedplate, five furnaces being used to melt the iron, in which 260,000 lbs. of metal were charged. Each furnace was charged with iron of the same average analysis and the melting of the metal was so timed that each furnace would be ready to tap at the right moment. Six ladles were used for carrying the metal from the furnaces to the mould, and four of these were poured at one time, after which the remaining two were poured. The actual time of pouring from the instant that the metal was in the ladles to the time they were all empty was 17 minutes. After the casting was poured, it was allowed to cool slowly in the sand in the usual way, and some idea of the enormous mass of metal involved can be gained from the fact that the casting could not be lifted out of the mould for 16 days. At the end of this time it was taken out and cleaned, and the heads, risers and gates were removed.

Fig. 2 shows the method of taking the casting out of the sand. It was raised by means of a beam and two overhead electric cranes. The nett weight of the casting, after the removal of the heads, risers and gates, was 240,000 lbs. In order to move the casting from the foundry to the machine shop, a special gun truck was utilised. The casting forms one of two bed-plates for an engine just erected for the Youngstown Sheet and Tube Company, of Youngstown, Ohio, U.S.A., the complete engine weighing over 1,250,000 lbs.

FIG. 1.—POURING A 240,000-LB. CASTING.

The Northampton Institute.

This session's meetings of the London Branch of the British Foundrymen's Association are being held at the Northampton Polytechnic Institute, St. John Street, London, E.C., accommodation having been kindly provided by the Governors, through Dr. R. Mullineux Walmsley. The selection of this Institute as the Foundrymen's meeting-place is a happy one, since it is one of the few such places where practical moulding and pattern-making are taught.

The engineering and pattern-making workshops are equipped with machine and hand tools, benches and appliances for the instruction of students, who can obtain in them a practical acquaintance with the use of tools and machines, and also of the methods of working and treating material and the preparation of materials for testing. In the woodworking shop the students are given work under an experienced pattern-maker, and the knowledge gained is

of value to them in connection with the designs as carried out in an engineering drawing office.

The evening pattern-making class is held in the carpenter's shop. The course of work is arranged to suit the individual needs of the students as much as possible, and each example is selected so as to exemplify some important point in pattern-making. The subjects dealt with comprise :—The position of mould joints; contraction of castings; amount of taper necessary; allowances for machining; loose parts for undercut moulds; cores, core-boxes, and prints; the halving of patterns; use of ramming boards; the turning of patterns in halves; methods of arranging patterns which have to be moulded in three-part boxes; construction of patterns for striking up moulds in loam; use of skeleton patterns; lagging and building up in segments; patterns for gearing, with the method of striking out teeth; materials and tools used in pattern-making; numbering, registering, and storing of patterns, etc.

Instruction in metallurgy is given in the Department of Technical Chemistry. For engineers (mechanical and electrical), brassfounders and workers, electro-platers, and others, a knowledge of the physical properties of the metals commonly used by them is essential. Further, the influence of small percentages of impurities is so great, in some cases detrimental, and of the highest industrial importance in others, that a knowledge of these effects and especially of the mixtures of metals, in the proportions necessary to obtain the most beneficial results, is most essential to all classes of metal workers.

The courses in metallurgy have been especially designed to meet these requirements. A laboratory has been equipped with wind and gas furnaces, gas muffles and all the necessary appliances for the production of alloys. By means of these appliances students are enabled to produce those alloys which have the greatest bearing on their work. The mechanical properties of the alloys prepared can be practically

Fig. 1.—Lifting 240,000-lb. Casting out of the Sand.

Short explanatory lectures are given from time to time by the instructor, and are supplemented by one or two special lectures on patterns for repetition work. All students in this class are expected to attend also in the drawing office on two evenings a week.

The practical-moulding instruction given is suitable to the requirements of the general engineering student and draughtsman who may have to deal with engineering design, in which it is of the highest importance that a knowledge of the principles of pattern-making and moulding should be acquired. The course is also useful to trade students in moulding who are just commencing practical work. Here again the work is arranged to suit the requirements of individual students. Short explanatory lectures are given from time to time by the instructor. Students taking up this course are recommended to attend one of the courses on "materials" and all students, unless already proficient in the subject, are required to take engineering drawing.

examined and their suitability for the purposes required ascertained by the apparatus provided in the adjacent laboratories.

Denison-Korte-Briquetting Machine.

In our issue of October last we published a description of the Denison-Korte machine for briquetting metal borings, and quoted the results of several tests which were understood to have been made with briquettes from the machine in question. We are now informed, however, that these results were obtained with briquettes from the Ronay machine of the Hochdruchbrikettierung G.m.b.H., who are now represented in this country by Messrs. J. W. Jackman & Company, Limited, of Vulcan Works, Manchester, and Caxton House, Westminster, and who published the results in question in their catalogue of August, 1910, during the time Mr. Korte was their representative in England. The test results which we quoted, therefore, can only be taken as applying to the product of the Ronay machine.

Foundry Sands and their Treatment.

By Algernon Lewin Curtis, M.E., A.M.E.A.O.[illegible], M.B.F.A.

Introduction.

Considerable discussion has taken place amongst engineers, founders, and metallurgists, concerning the various practices adopted for selecting and mixing pig-irons, but hitherto little attention has been given to the selection and treatment of sands and materials used for making cores and moulds. To-day, few founders are troubled by the evil effects of iron mixtures, though each contribute their quota of bad castings to the scrap heap, and in many cases the iron, or iron mixture is blamed. It can be stated, however, without fear of contradiction that few modern concerns are using mixtures which cannot be altered or changed by the most elementary means, so that as far as the mixture is concerned, there need be little fear of its being responsible for wasters.

Much of the trouble appearing in foundries to-day, where scientific and experienced methods are employed (excluding segregation) is trouble occasioned by sand or moulding materials, either through being too high or too low in quality, or being unevenly mixed, blended and bonded. Several methods are in use for treating moulding and core sands, of which the "kneading" process can be classed as *facile princeps*, though the others show that no little attention has been given to the subject. The common method of mixing core and facing sands is to "cut" them over on the foundry floor, and oftentimes this represents part of a moulder's work. Little thought and less experience is required to see that such a process is a poor one for thoroughly mixing and incorporating together any two materials; then how much more difficult is it to mix three or more kinds of sand, besides compounds, by such a process? For the sake of argument, let it be admitted that the practice of "cutting over" sand is a good and cheap method of mixing. The following can then be deduced. One good man will cut over with a shovel four tons of sand in an hour; but sand cannot be thoroughly or evenly mixed unless turned over at least a hundred times (and more, if homoegenity is desired). Then twenty men have to be employed one hour by this process to prepare four tons of sand fit for a mould, which in itself is absurd. In the average foundry moulders cannot wait long for their sand, and in consequence have to use it only "cut over" once, in which condition it is unfit for use, when compared with properly treated material.

Such facts should in themselves be sufficient to condemn the practice of "cutting over" sands, when used as a means for mixing. Every natural sand-bank, wherever located is so constituted that its bonding constituent, or percentage of natural clay, varies from 1 to 7 per cent., so that if a car-load is taken from a pit, it usually comes from several parts of the bank, and therefore is in its original state unmixed. This new sand when delivered to the foundry is added to old sand, in proportions varying from 5 of new to 4 of old, down to 1 of new to 100 of old, according to the nature of sand and work required.

It must not be forgotten that the old sand hitherto has never been properly mixed, and to this so-called mixture is added new sand, also unmixed. The whole bulk is then cut over with a shovel and designated mixed. If this mixture is now carefully examined, batches will be found with natural clay, or bond, as high as 10 per cent. in some parts, while in others little or no clay can be discovered, clearly showing that the material is too patchy and unmixed to make good, sound moulds or cores.

In addition to the process of cutting over being wholly inadequate and inefficient for sands, it is also an expensive one, and the money invested in labour in this direction could be more profitably employed elsewhere in the foundry. Sands which are cut over, it will be found, must be impregnated with compounds to establish their identity, and therefore many foundries to-day are "doping" unmixed sands to make them do their work; whereas, if they were properly mixed, blended and bonded, very little "dope" or compounds would be necessary. Compounds are very useful in their proper place, but compounds spell gas, and gas means trouble, so the safer way is to use a maximum sand mixture, with a minimum of compounds.

Among founders there are a few who rejected the "cutting-over" process on account of its expense, and employed the pan mill or concrete mixer. Disciples of these processes have been encouraged in their investigations by enthusiastic machinery makers, and although they have substituted the pan or mill for the shovel, they still get bad and scabbed castings. The pan mill, or concrete mixer, does effect economy in labour, and perhaps that is why the system is adopted; but it uses more sand than its antiquated neighbour. There is one thing, however, that a moulder should not use, and that is dust. It makes no difference whether the work be brass letters, or turbine casings, a mould built up with sand which contains a quarter of its bulk in dust will spoil the casting. A wet or dry pan mill, or concrete mixer, must necessarily, on account of its construction, reduce a large portion of the material put into it to powder or dust. If such machinery is going to attempt the art of mixing and incorporating, it must grind, and during the process it is reducing the particles of silica to powder, its capacity for reduction in this manner varying from 25 per cent. to 35 per cent. of the total volume.

Much has been said in favour of wet and dry pan mills, and the grinding action looked upon as a "theory"; but if any experienced founder will carefully examine under a microscope samples of sand that have been treated 5 minutes in a pan mill, and then examine the same material before it is treated, he can satisfy himself upon the merits of the pan mill as being an admirable grinding apparatus. If further experiment is necessary, pass first an untreated and then a treated sample through various sized sieves, or build a model winnowing machine; these tests will give the actual amount of dust contained in sand treated by wet or dry pan mill or concrete mixing machinery.

Where is the pan mill more popular than in steel foundries, and what manufacturing establishment suffers more through having wasted work than a steel foundry? One reason is this—a mould for a steel casting may be made up of sands that have been ground, and consequently their texture is too dense to allow the strong gases of liquid viscuos steel to escape, and therefore they come back through the partly molten metal. The great trouble with sand containing quantities of dust, when used in a core or a mould, is that dusty sand must be impregnated

with some organic substance in the form of compound to make it strong enough to resist the pressure or head of molten metal. If it is thoroughly saturated, directly the molten metal reaches the organic substance, a film of gas is raised which cannot altogether escape by the mechanical vent, on account of its volume, and the natural vent is retarded because the porosity of the sand has been affected by dust and organic substances.

To attempt to mix sands in either a wet or dry pan mill, or a concrete mixer, is a dangerous proceeding, as such apparatus will not do what is really required, that is, knead natural clay or bond out of new sand into the body of an old or recovered sand; but they can and do grind sands to dust, which, if used, may give disastrous results.

Having outlined the best known processes, it now remains to breifly show how core and moulding sands should, and can, be properly mixed, blended and bonded. Before dealing, however, with the subject of mixing, blending and bonding, perhaps a definition of the proper selection of raw material will not be out of place. The high grade founder when selectings his sands, requires the following:—A sand which contains a high percentage of silica, having a grain or constituents of suitable size for the work required. Such a sand must be very refractory, that is, possess a high fire test, due to its silica, and its fusing point be above that of iron or steel, according to the work. It must contain enough clay in its composition, so that when mixed with heap, core or facing sand, the necessary bond is established in the mixture. If founders will be guided by this rule, they can rest assured that their raw materials will be satisfactory, and it will then be only necessary to treat them in a suitable plant, in order to save, first, sand bills; second, labour; third, compounds; and lastly, to ensure good and sound castings.

(to be continued.)

Correspondence.

Education and the "Sandwich" System.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In the very interesting Paper given by Mr. Hayes before the London Branch of the British Foundrymen's Association, one educational method advocated by the writer was the so-called "sandwich" system of education, *i.e.*, half-time to be spent at a technical school, and the other half at a works, the technical school work having a direct bearing on the student's or apprentice's vocational work, to be continuous for a definite period, apparently during the whole time of the apprenticeship.

This idea is, superficially, ideal, and calls forth every measure of support till we consider the far-reaching effects, if such a system were made law. One of its chief effects upon skilled crafts would be that one source of healthy competition, and incidentally the fiercest, would be eliminated. I refer to the "little master" man who depends on youthful labour for his position as an employer and competitor in the market. This class is, admittedly, the greatest enemy to any Trust formation that we can have, and for this alone is entitled to our respect and a given place in the competitive world. I take it, as a generally accepted fact, that Trusts mean extreme specialisation, which specialisation is certainly not to the advantage or well-being of any skilled craft.

One is told that the "little man" is an exploiter of boy labour, and being so, his existence has a deteriorating effect. Is this so? I think we may take it as a logical sequence that before you can exploit, you must produce, and before productivity you must instruct. Does it not then follow that the "little man" will instill into his youthful employés all that tends to greater productivity? This must be a gain for the youth as well as the employer, inasmuch as he gets the full benefit of ripe experience, which means the quickest, most skilful and economic methods, and these being essential to any craft, in what way are they detrimental to its well-being?

It is invariably the small jobbing shop that turns out the best all-round class of skilled workman, which class, owing to the diversity of the training under the limitations imposed by not having access to every labour-saving device, are taught not only to use their hands, but also their brains. Most "small men" insist on their apprentices attending evening technical classes in connection with their work, in some cases allowing small privileges such as a few hours off from work (for which they are paid), this being vastly different from a system of half-time, which from a loss of labour alone would wipe the small employer out of existence as a potential factor in the productive market.

To condemn one idea without substituting another is unfair, but personally I would rather see the apprenticeship system considerably strengthened and enforced, the responsibility of training being equally thrown on the employer as well as the employé. This might be done by granting, after examination, a certificate of efficiency, which if not gained, should be withheld till such efficiency was proved. It would thus follow that without this certificate no person would be allowed to follow or work at a skilled trade. The employer whose apprentices failed to prove their efficiency could be curtailed in the number of apprentices he could employ, thus rendering it necessary for him to see that his youths were fully qualified, otherwise not allowing him to have any apprentices or boys in his employ.

I am quite in agreement with Mr. Hayes that the school age should be raised, though not to the age he advocates (18), but rather keep the primary education standard as at present (14) with two years' *free* technical training, thus allowing the boy to choose his vocation by having a previous insight into its workings and requirements as would be given at the technical institutes for all branches of professional work.

Yours, etc.,

J. GORDON.

London County Council School of Engineering and Navigation, Poplar, E.

Reply.

I regret that considerations of time did not allow the foregoing criticisms to be fully answered when raised during the discussion before the British Foundrymen's Association. But since the opinions voiced by Mr. Gordon appear to be held by others, a more public reply will be advantageous.

The contentions of Mr. Gordon are, briefly, that the independent small master man is the most effective check to the operations of the Trust; that an excessive supply of boy labour is essential for the existence of the small master; that the small jobbing shop is the best training ground; and that the Trust or large combination as an employer stands for extreme specialisation. In regard to the first point, that may be admitted tentatively. The second contention, however, presumes that the small employer (stated to be dependent on cheap boy labour) alone has access to same. Surely this is a fallacy, since any employer of any size has equal access to the labour market. The truth is that an attempt is often made by small men to offset bad equipment and bad organisation by cheap (and incidentally untrained and inefficient)

labour; while in a better equipped and better organised establishment an excess of such labour is a nuisance. In support of that may be quoted many cases of small men who will not employ apprentices, as they are deemed more trouble than they are worth. Under conditions of bad equipment and bad organisation cheap boy labour can only be made profitable by the system of specialising at the expense of training which Mr. Gordon condemns in the Trust. There will be found few advocates of such specialisation. Mr. Gordon also ignores an important economic fact, viz., that any supply of labour which can be made a source of profit to an employer automatically becomes employed, and at a rate in keeping with the value to the employer. If boys were the invaluable asset to the small man (or any other, for that matter) which is implied, they would naturally and automatically command a better wage. It may be accepted as a sound economic fact that the wage of labour of any class keeps very close to its value under the conditions in which it is employed.

The remarks in the third paragraph of Mr. Gordon's letter miss the mark entirely. My contention was not that the small man alone was liable to exploit boy labour at the expense of training it, for obviously any employer, large or small, may do that; I merely claimed that *any* concern which accepted boy labour at cheap rates under the pretence of training it, but which instead simply applied it to a routine operation of production, was economically unsound, if that procedure was necessary to its existence. To claim that the employer must train his boys to produce before they can be exploited is to state only half a truth. To attain full productive capacity proper training is essential; but to attain efficiency at a *few* operations, the produce of which will be a good return for a boy's wage, frequently requires little training. Consequently, there is a tendency to employ boy labour in the latter way, training it only to productivity suitable for a boy's wage and ignoring the fact that the higher wage which the boy will later require necessitates a much fuller training on his part to earn it. Where the larger outlook is taken and the boy's value during the later years of his training period is considered, the master frequently does "instill into his employés all that tends to greater productivity," and the boy is given "the full benefit of ripe experience." In the present lack of control of boy labour, however, there is nothing to prevent a man employing a boy for, say, only a year, and after a few weeks' instruction at a simple operation, keeping him at that work entirely that he may give an abnormal return for the small wage he is paid, then finally discharging him when he demands a wage in keeping with his years. I have used the term "exploit" in the recognised sense of "drawing an illegitimate profit from"; and hence, there should be no confusion between exploitation and the training of young employés to the maximum productive capacity, even though the latter is to the benefit of the employer.

Mr. Gordon next raises the question of the value of the small jobbing shop as a training ground, and remarks that most "small men" insist on their apprentices attending evening technical classes, etc. I quite agree as to the value of the small shop for training purposes, provided it conducts modern processes, and is organised on proper lines. But what percentage of small foundries, for example (say, of those employing less than ten men), are conducted on modern lines? Also, in what way can the jobbing shop be said to compete with the Trust? They must essentially operate on different classes of work. The real competition of the Trust is the small *manufacturing* concern, which by reason of low standing charges, intimate personal control by the principal or manager and careful organisation, combined with suitable equipment, can produce cheaply. If, however, small concerns are not operating on these lines, but are making illegitimate use of any class of labour at the expense of that labour or the supply of competent men to the trade, they are, I contend, economically unsound. Further, even though most small employers may insist on attendance at evening technical schools (a very doubtful assertion), that is the wrong time to attempt instruction for a boy who has had probably 10 hours hard work in the foundry, and is in the evening fatigued and disinclined for any effort, either mental or physical. My claim is, that such instruction should be part of the normal training and not be a supplementary feature at the expense of the boy's justifiable leisure and relaxation.

Mr. Gordon appears to favour the revival of the old apprenticeship system, which in most industries is dying a very natural death. The rise of the system in past centuries, and the effect upon it of industrial evolution is too big a subject to treat here at the moment; but I may remark that resuscitation, while it may appear desirable, can only be a temporary expedient. The old system is dying because it is in some of its features not constituted for modern conditons; it is being eliminated in the course of evolution; but there is no reason why a bolder, more effective and altogether fitter scheme should not be erected on its ashes. Such a scheme, I consider, should be based on national control and effective vocational training (variable in time and nature according to the industry) during the critical period of adolesence.

May I, in conclusion, suggest that Mr. Gordon labours under the same misconceptions which have rendered effete the efforts of most educational congresses in the past; the belief that because certain features exist in our systems and other features have in gone days proved valuable, they must of necessity be incorporated or revived in any new system. It is essential in any constructive scheme, first to determine the end to be attained, and then to arrange the best means of attaining that end; and, further, to only apply or utilise any existing means to such extent as is found to comply accurately with the requirements. The "sandwich" system of training has, I am aware, proved unsuccessful when applied to a small section of engineering students introduced into works operating for the main part on a different principle; but that has no bearing on the question at issue. It may be noted, too, that Mr. Gordon at once jumps to the conclusion that I am advocating the half-time system for all trades—quite an incorrect assumption. May I counsel him to study the spirit of the suggestions put forward, rather than assume that I am advocating some rigid system which has already prove a failure.

Yours, etc.,

ALEXANDER HAYES.

London.

[EDITORIAL NOTE.—Since the points raised in this correspondence are more or less contentious, we invite the opinions of our readers on the matter.]

London Foundrymen's Annual Dinner.

The annual dinner of the London Branch of the British Foundrymen's Association will be held on December 14, at Holborn Restaurant, W.C., when an excellent gathering of the members and their friends is anticipated. Last year's function was well appreciated by the members, and formed an excellent means of bringing non-member in the trade into touch with the objects of the Association. Tickets for members and their friends can be obtained from Mr. T. Murphy, Gamage Buildings, Holborn, W.C.

British Foundrymen's Association.

Sheffield Branch.

The members of the Sheffield and District Branch of the British Foundrymen's Association had an interesting evening on Saturday, October 26, when Mr. J. G. Robinson of Halifax, gave a lantern lecture on "Moulding a Water-Jacketed Gas Engine Cylinder." The lecture, which was given at the Literary and Philosophical Society's rooms, Sheffield, was presided over by Mr. Percy Longmuir, Branch-President. The slides with which Mr. Robinson illustrated his lecture were from photographs of work in progress under his supervision. The lecture, which was given by Mr. Robinson at the annual convention at Cardiff in August, and was published in our issue of September last, described the methods adopted at his firm's works to secure sound and clean castings. Describing the processes depicted in the views shown, he said that there would be noticed a variation in the thickness of the metal at the point where the flange is connected with the inner and outer walls of the cylinder and also at the opposite end where solid blocks are cast in to receive the studs for attaching the end cover. During machining operations these two points had been found to exhibit a spongy nature and had proved a prolific scource of trouble. This, however, had been overcome by the use of chills and a suitable mixture of metal. He explained that the chills were introduced in order to close the grain of the metal and obtain an even rate of cooling in the thick and thin parts of the metal. The old-fashioned foundrymen, he said, were afraid of chills because they were afraid they would get hard white iron and cause trouble in the machine shop, but by judicious use of chills and knowing the correct thickness to use, they could get the effect they desired.

The PRESIDENT remarked that it was not often that they got a Paper of such a practical character. He had been most interested in Mr. Robinson's reference to the use of cast-iron chills, and he thought that his method of varying the thickness of the chill was one open to very high admiration.

MR. HARDWICK asked if the chilling of the metal was detrimental to the cylinder in the machine shop. He observed that if they had a few lectures of that description the attendance of the Sheffield Branch might compare favourably with Halifax.

MR. PEERS asked if Mr. Robinson had cast his cylinders with very hot metal. Did he prefer metal as hot from the cupola as he could get it, or not?

MR. HYDES enquired if there was any method of treating the oil-sand so as to prevent it blowing?

MR. POWELL said that up to about three years ago he had no practical experience of oil-sand, but he had experimented with it since. He asked if it would serve for very heavy work, whether the oil would melt out or what it would do in that respect. In using oil-sand difficulty was often experienced in turning the cores, for as the sand was so soft and pliable it would often put them out of shape. Was there any way in which that could be altered?

MR. GIBSON said he had had considerable experience with oil-sand and found it was essentially good for flywheels and rope wheels to anything up to 16 tons. As for the fall of metal on cores made with that particular sand, he had had no great difficulty. He had always used raw in preference to the boiled oil. Formerly he had difficulty with valves, so he adopted the chill system. From the day they introduced the chill they never had a valve returned through sponginess, and never had one to burn; and they ignored feeding altogether.

MR. ROBINSON, in reply to Mr. Hardwick's question as to whether there was any difficulty experienced when boring these castings in the machine shop, said the only trouble was that sometimes caused through carelessness on the part of the core makers. They did not always get the chills to follow one another in a circle. If they were put round perfectly true there would be no trouble in boring. They had really never had any trouble at all from the use of a chill on the inside. Mr. Peers had raised the question as to whether he preferred casting the cylinders with metal as hot as it was possible to get it, or whether it was preferable to allow the metal to cool a little in the ladle. A few months ago Mr. Peers had a controversy with another gentleman in the FOUNDRY TRADE JOURNAL, and as he should not like to set himself up as an arbitrator between the two he had to be a little bit careful.—(Laughter.) It was possible to get their metal so hot sometimes that the moulds would not always stand it. They had to take that into consideration as well as the benefit of the casting. He believed the hotter they could pour a casting the more solid they would get it. There were times when he let the metal stand in the ladle until he considered it at correct temperature for work. He did not believe in casting everything as hot as possible. Mr. Hyde had raised the question of oil-sand blowing. He had never known any oil-sand really to blow. There was, however, a certain amount of gas generated, and it had to get away somewhere. The question of using boiled oil was referred to by Mr. Gibson, and he agreed they got better results from raw oil than from boiled oil. The latter seemed to separate out on to the skin of the core and they got a harder skin than they did from the raw material, and metal would not lie quietly on a hard surface. There was no question, however, about the saving in cost. A few months ago he was without oil for about a week, and at the end of the week he was about three days behindhand in the fettling. Even in the class of work he had been describing, the cost of core making was reduced at least 30 per cent., and fettling anything from 75 to 100 per cent. He should not like to be without it. Another gentleman raised a question as to whether the oil-sand could be used for splitting bosses of flywheels. He had cast one the previous day weighing from seven to eight tons, and had cast another weighing from eleven to twelve tons, and the boss was split with oil-sand cores. He never had any trouble with it. With respect to the cores getting out of shape, there was one method they adopted to bind the oil-sand together. They tore up a piece of wood-wool band and mixed it thoroughly with the sand, and this formed an additional bond. It was a bond which acted until the bond of the oil took effect through baking. This was one of the methods he adopted for holding a big core up to its place. They had no special method of mixing the sand. They damped it to whatever degree of moisture they required. The correct consistency was learned by practical experience. Then they mixed on an average one pint of oil to about five shovelfulls of sea sand. A shovelfull of sand they could estimate as equivalent to a gallon. For best work they used one pint of oil to four shovelfulls and one pint to six shovelfulls for common work. After the oil was mixed with the sand it was turned over with the shovel and put through a ¼-in. riddle and then through a ¼-in. riddle. Mr. Gibson said he had used oil-sand cores on flywheels and rope wheels up to 16 tons. He (Mr. Robinson) had used it for split-

ting the bosses on flywheels up to 14 tons. They did not go any higher than that, but he had used it for the grooves on rope wheels up to ten tons on the outside. Some people did not put cores in the grooves on rope wheels but preferred that method, making the core in oil-sand. Mr. Gibson mentioned that he had had no difficulty in the fall of the metal. They had found it was liable to cut up a little bit, and on the very deep ones they adopted the method of running in at the bottom. With respect to the use of raw oil instead of their Halifax mixture, he was not going to say that the raw oil was not better, but it was certainly not cheaper. He granted there was nothing better than the linseed oil, but at the week's-end, when enquiries were made as to what it had cost, they saw it was not just an occasion for using the best material. Mr. Gibson had also mentioned that he had ignored feeders altogether in the making of valves. He had done the same thing with all their liners. If they could get away from the human element and get to the mechanical they would do away with variation, and they found that was what happened by using chills on their castings.

The CHAIRMAN briefly moved a vote of thanks to the lecturer.

MR. CROWTHER, in seconding, said there were many points in the lecture worthy of great attention. Some time ago he went through a large foundry in London where 250 hands were employed, and he was struck with the large number of chills in use there. The manager of the foundry told him that within the last three years they had reduced their cost some 5 per cent. by the use of chills. He wondered at the time whether he was drawing the long bow, but he was inclined now to believe he was not. The more there were great variations in the thickness of the body of castings, the more chills would have to be used.

Halifax and District Branch.

The members of the Halifax Branch of the British Foundrymen's Association held their first meeting of the Session in the Municipal Technical College, on Saturday afternoon, October 17.

Arrangements had been made for a Paper to be given, entitled "The Physical Properties of Cast Iron," by Mr. F. J. Cook, of Birmingham, who, unfortunately at the last minute was prevented from attending. Mr. J. G. Robinson, Hon. Secretary of the Branch, accordingly presented the Paper on "Moulding a Water Jacketed Vertical Gas Engine Cylinder," which was given at the Cardiff Convention, and reported in the September issue of the FOUNDRY TRADE JOURNAL. In the absence of the President, Mr. H. Campbell, who was away owing to ill-health, the chair was taken by Mr. W. Smith.

The lecture was illustrated by lantern views, and proved very interesting.

In opening the discussion, MR. FRANK BERRY said that although he was not in practical touch with the making of jacketed cylinders, his general knowledge of the art of moulding led him to think they had nearly reached perfection at the Campbell Gas Engine Company's Works in this direction.

MR. J. W. SYKES asked the lecturer's opinion of oil *versus* core gum as a binder for sea-sand cores. He had knowledge of one founder who preferred core gum for motor cylinders.

MR. F. LIMB, speaking in regard to chills, asked if there was any difficulty in machining the chilled parts.

MR. R. PICKLES asked whether any leakage occurred where the studs were fixed against the jacket core, and also about the shrinkage in oil-sand cores; was it a similar contraction to that of iron? He had made thousands of oil-sand cores and had not noticed it.

MR. ROBINSON, in replying, said that in each section of the trade there were difficulties that could only be overcome by actual practical experience. He preferred oil binders to core gum, one reason being that core gum dried with a hard face on which metal would not lie quietly. Also if left in a moist atmosphere the cores would perish, whereas oil resists moisture. Regarding the question of a hard surface where chills were used, they had no difficulty in machining the casting. The chills were of such a thickness that they did not bring out a white chill on the casting, but only closed the grain and gave an equal rate of cooling on the uneven thicknesses, which was what they desired. Mr. Pickles had misunderstood the term "shrinkage." The expression used was "sinking." A core 9 in. deep would sink or settle ¼ in., and would only be 8¾ in. deep when dried. With respect to leakage around studs, he had never seen any. They always cast those cylinders with fairly hot metal.

MR. W. SMITH moved that the best thanks of the meeting be accorded to Mr. Robinson for his Paper, and referred to the short notice that Mr. Robinson had had. He felt that none of them had spent their afternoon in vain.

The motion was carried unanimously.

Leather Fillets for Pattern Makers.

Leather fillets have found plenty of scope in pattern shops owing to the labour saved and the ease with which they give the correct radius in awkward places When using the fillet should be placed face down on a board, and plenty of good glue applied to the curved sides. The fillet should be rubbed well into place with a round stick, the diameter of which should be double the size of the fillet, and the surplus glue removed with a damp cloth or sponge. When dry the fillet should be sandpapered well. Nails or tacks should not be used in fixing it, as they draw the material and leave an uneven surface. For fixing to iron patterns heavy shellac should be used instead of glue.

Spermolin for Core Making.

The core-making material called "Spermolin" has come before our readers in several recent articles in our columns, so a few particulars regarding its use may prove of interest. Previous methods of making cores have necessitated venting the cores, the sand being held together by bonds and core rods; while also fettling the cool casting was a task of no little trouble and labour. The use of Spermolin is claimed to displace all necessity for core-rods and venting, as it is in itself an exceedingly strong bond. To obtain the best results it is necessary for the sand to be pure silica, such as sea sand and river sand, and the resultant cores are absolutely porous; good results can also, however, be obtained with other sands. The cores are so strong that they will not crush or break when the metal flows into the mould and the Spermolin in them burns out rapidly enough to allow them to crush as the metal shrinks about them. The material gives off only a little gas, which is no way injurious to the eyes or health of the casters, and the cores being homegenous and porous throughout, minimise the tendency to blowholes in the castings through insufficient venting. Particularly for all small cores is this material suitable, as when they go to the dressers there are no core rods to be got out; all that is required is to rap them, when the sand will run out like fine powder, leaving a nice clean surface. One founder states that he has used this material to paint the moulds, and finds that he can dispense with sprigging the face and sides of the same. He has used it on castings from 1 cwt. up to 5 tons, and has not had one scab of any consequence.

New Method for Mechanical Tests of Cast Iron.*

By C. Fremont (Paris).

For a century cast iron has been tested by bending test bars. At present important specifications prescribe tests for two qualities :—Tensile strength and resistance to impact. One Government Department recently made enquiries among the ironfounders on its list of contractors to ascertain what test they considered the most suitable; but the answers received were so divergent that no practical conclusion could be formed. It is therefore interesting to compare the different methods of applying mechanical tests to cast iron.

The author proposes to compare the results obtained, from one and the same cast iron, with bending, tensile, impact and shearing tests. In order to compare the results of the tensile and bending tests, he operated on 140 test bars from different foundries. In the heads of these test pieces small prisms were cut out measuring 8 by 10 by 30 mm., which were subjected to statical bending tests in a machine which recorded the amount of force applied. In general it was found that two specimens of cast

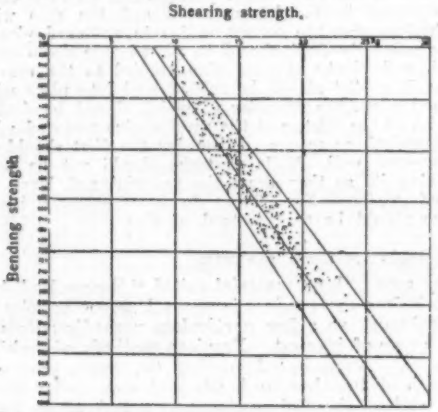


FIG. 1.—DIAGRAM SHOWING THAT, IN THE CASE OF CAST IRON, THE SHEARING STRENGTH IS PROPORTIONATE TO THE BENDING STRENGTH. (THE ABSCISSÆ GIVE THE FORCE REQUIRED TO FRACTURE THE TEST PIECES IN THE BENDING TEST, AND THE ORDINATES THE CORRESPONDING SHEARING STRENGTH.)

iron with an equal breaking strength under statical bending tests may vary considerably in tensile strength, the ratio being in some cases as high as 2 : 1.

Since, in the bending test, a prismatic test piece breaks by the tension exerted on the bent portion, one ought to obtain concordant results in both kinds of test (bending and tensile) when applied to the same cast iron, except for the differences due to heterogeneity of the metal. As this is not the case, some other intervening cause must operate.

Now, the coefficient of elasticity of cast iron varies between wide limits, being three times as much in some cases as in others. Thus, for instance, if we take two similar test pieces, one of inferior and the other of very good cast iron, the bend produced under the same load in the bending test will vary according to the quality of the metal, and may be three or four times as great in cast iron of low quality as in the better quality metal under the same conditions. Owing to this high capacity of elastic deformation, the test pieces of poor cast iron will give in the tensile test, whereas, other conditions being equal, the test pieces of good cast iron break prematurely by flexion. The fact is well known to practical men, for it is often noticed in making tensile tests that the test pieces break in the holders, where the sectional area of the piece is much larger than in the body of same. It will be evident, therefore, that if the differences observed in tensile tests are due, in the case of bad cast iron, to the heterogeneity of the metal, the cause of the differences cannot be the same in the case of good cast iron, but is due to the low elastic property which is inversely proportional to the strength of the metal.

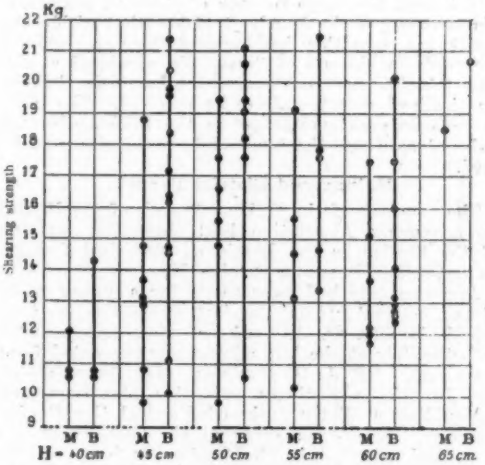


FIG. 2.—DIAGRAM FURNISHING A COMPARISON BETWEEN THE RESULTS OF IMPACT AND SHEARING TESTS. (THE ABSCISSÆ GIVE THE HEIGHT OF FALL OF THE WEIGHT, AND THE ORDINATES THE CORRESPONDING SHEARING STRENGTH.)

The author vainly endeavoured to correct these deviations from the truth in the tensile strength of the test piece, by placing a pad of copper under each head. To compare the results of bending and shearing tests he has worked with 267 pieces of cast iron, derived in part from test pieces from impact and tensile tests, and in part from old castings. The results have been plotted on the diagram (Fig. 1). We find a sufficiently complete correlation exists between the two kinds of tests : statical bending and shearing. The author has made over two thousand tests and has been able to confirm that the differences are entirely due to the heterogeneity of the metal, and that they diminish in proportion as the quality is higher. In order to compare the results of the impact and shearing tests, experiments have been made on the fragments of 37 test pieces from impact tests carried out by a railway company. These

* Abstract of Paper read at the New York Congress of the International Association for Testing Materials.

pieces, of square section (40 by 40 mm.), which had been fractured by the impact of a 12-kilo. drop hammer, were sawn so as to furnish two prismatic test pieces measuring 8 by 10 by 30 mm., one being taken from the edge and the other from the middle of the large test pieces, for the purpose of applying bending and shearing tests as in the preceding cases. The necessity for taking two test pieces was caused by the difference in the quality of the metal, the middle portion being weaker in consequence of segregation. The results of these tests have been plotted in (Fig. 2). In the abscissæ, M represents the results obtained with the test pieces from the middle, and B those taken from the edge of the fragments broken by the impacts produced by the hammer falling from progressively increasing heights, viz., 40, 45, 50, 55, 60, and 65 cm. respectively. The ordinates give the results of the shearing tests per square millimetre of sectional area.

One sees that there is no relation between the results of the impact bending tests and the shearing or statical bending tests (since we know that these two tests are in harmony). The cast-iron specimens which fractured under a low height of fall—45 cm. —gave shearing strengths varying between 10 and more than 21 kilos. per sq. mm.; whilst the specimens which required the comparatively high fall of 60 cm. to produce fracture, gave shearing strengths of 12 to 20 kilos.

This great divergence between the results of the impact tests and of the statical bending or shearing tests is explained by the variation of the coefficient of elasticity in inverse ratio to the tensile strength of the cast iron. In fact, if we take the case of two similar test pieces, one of which, however, is of poor and the other of very good cast iron, the force necessary to fracture them by impact will differ but little, because though the force required to fracture the poor iron is smaller than that needed in the case of the good iron, the poor iron will bend more under flexion than the good iron, and there will be only a small difference in the product of the two factors, force and deflection, in the two cases. The presence of dust or oxide, forming a pad under the test pieces at the supports, or the use of a lighter anvil base, will constitute a sufficient cause to influence the results of the tests considerably.

It should also be noted that, although the impact test be necessary in the case of iron and steel because these metals, subjected to different conditions, may exhibit different methods of fracture, this test is not essential in the case of cast iron, this kind of metal exhibiting only one method of fracture between the grains, namely, granular fracture, no matter whether the test be static or dynamic.

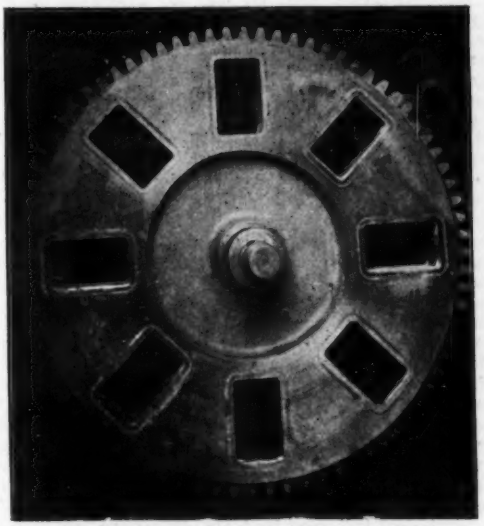
In short, it may be asserted that the impact bending test does not indicate the strength of cast iron; and that the tensile test can never be performed with sufficient accuracy, whatever the care bestowed and the precision of the apparatus, since the test piece can never be pulled in an absolutely axial direction. Statical bending and shearing are the only mechanical tests capable of revealing the quality of cast iron. The manner of taking the sample for testing is also of great importance; and tests applied to a test piece that is cast specially for that purpose will give only approximate information on the quality of the metal.

To obtain accurate information it is essential to take the test piece from the actual casting that is to be ultimately used in practice.

In order to attain this result, we must be able to take small test pieces; and this the author has done in the majority of instances by boring, in a special manner, holes which are intended ultimately for the purpose of assembling the castings, or else can be plugged up again if found necessary. These holes are 14 mm. in diameter, and are bored by a tool in the shape of a trepan, which leaves in the centre a cylindrical core 7.5 mm. in diameter. This core can be broken off with ease at the base, by a small special tool, and can then be shaped into a square prism of 5 mm. side. Shearing tests are applied to the prism at intervals of 3 mm. lengthwise, in order to ascertain the strength at the periphery and various depths. These shearing tests will give accurate information on the quality of the cast iron, with rapidity and economy.

A Phosphor-Bronze Mould Plate.

Our illustration shows what is certainly one of the most expensive mould plates designed for briquetting purposes, recently supplied by Messrs. Yeadon, Son & Company, Leeds, to the Namaqua Copper Company, Limited, for use at Concordia, Namaqua Land. Early in the present year Messrs. Yeadon



A Phosphor-Bronze Mould Plate.

supplied a complete plant to the Company mentioned for the purpose of briquetting fine ores, flue dust and slimes. Steel for the moulds was found commercially impossible owing to the excessive wear due to the acid contained in the slimes, it was therefore decided to make the mould plate of phosphor-bronze. The plate illustrated is 3 ft. 10½ in. in diameter by 5 in., and weighs 15 cwts. It is designed to produce briquettes 7½ in. by 4½ in. by 4 in. It will certainly be interesting to learn how this mould plate will stand the abrasive action of the material to be treated.

Writing in a contemporary recently, William D. Bancroft stated that on account of the ease with which an alloy containing about 66 per cent. Al and 34 per cent. Zn. absorbs Si., it cannot be melted in Hessian nor in ordinary graphite crucibles, but only in those made from bars of pure artificial graphite. The alloy is melted in a gas-blast furnace, stirred with a porcelain tube containing a thermo-electric couple and cast 50 deg. above its solidification temperature (never above 700 deg., for aluminium absorbs carbon at this temperature). When treated in this way the maximum mechanical properties are obtained, because the crystals formed are very small.

Discussion on Coke.

A meeting of the Lancashire Branch of the British Foundrymen's Association was held at the School of Technology, Manchester, on Saturday, Nov. 2.

Mr. F. Penlington, who presided, said that late in the previous session the question of "Coke" was brought forward, and members present were interested in the discussion which arose. Time did not permit, however, of the subject being dealt with as fully as some would have desired, and the report which appeared in the official organ of what was actually said was read by many of them with surprise and even disgust. In fact they felt they had a grievance against the Foundry Trade Journal, which was supposed to report their proceedings, and with a view to clearing up the subject their Secretary, Mr. A. Harrison, had kindly consented to re-open the discussion that afternoon, and give them a further chance of having a fuller report.

Mr. Harrison said he had no intention of re-opening the whole subject, because he had one or two more problems to bring forward. The queston was a very big one, and on the last occasion he thought they got some information and derived some benefit from the debate. At the same time they got a very brief mention in the Foundry Trade Journal, which certainly misrepresented what they did. A comment on the discussion also appeared in the Journal, headed "A Coke Question." [Mr. Harrison here read the leaderette from the Journal for July, page 401.] It was evident, he continued, that there was something wrong somewhere, because he had opened the discussion by stating definitely that given two cokes of identical chemical composition there would be differences in the results. It was, however, really a question not of chemical composition but as to which of two cokes of similar composition was the better, a heavy coke or a light coke. Of course, there were many side issues, and he mentioned one or two of them. They were all agreed that the use of coke was simply to melt iron. With a heavy coke it was possible to burn more completely than with a light coke, owing to the absence of air spaces—the specific gravity of coke was approximately that of water, namely, 1,000. He believed he mentioned last year that Mr. Buchanan laid down that a good coke must just sink in water. In looking over a number of notes he had on cupola coke and cupola work generally, particularly in the American and other papers, he was astonished to find what a diversity of opinion there was on the subject. Mr. R. Buchanan preferred a heavy coke, but others, including Mr. F. J. Cook, declared that the coke should be as light as possible. It was also maintained that the cellular structure was an important factor in the burning of the coke in the cupola, and further that the burning was best accomplished when the smallest surfaces were offered. Moreover, by using a dense, heavy coke less room was taken up in the cupola, with the result of there being less variation in the melting zone. The question, therefore, as to which was the better coke was a difficult one to settle, so many points having to be considered. He hoped members present would express their views freely on the subject, bearing in mind that the question was—given two cokes of identical chemical composition, which was the better, the heavy, or the light coke. "It is well known," said the Foundry Trade Journal, in the comment he had previously read, "that a light coke may be high in carbon and of good strength, making it very suitable coke for the cupola, or it may be hopelessly weak and high in ash; while the same applies to heavy coke as such." But carbon had nothing to do with the density of the coke; the closer the coke was knitted together the greater would be the specific gravity.

Mr. Simkiss said he stood by light coke, his experience having generally been with light hard cokes. The subject was a very wide one, and they might go on arguing about it for a long time. There was one point which Mr. Harrison raised with regard to coke being charged by weight or by bulk. He himself charged by bulk, and if they got a larger quantity of coke in the weight it was to their interest, providing it stood up under the weight of iron charged. He thought that had a good deal to do with the question of the cost. There were various methods of charging, and he himself preferred light (6-cwt.) charges. No difference took place in the stoppage or start of melting; the light charge occupied very little space, and he contended that the blast pressure going through thoroughly permeated the coke, which was forced into complete combustion in a body. When coke was charged to 12 in. in a furnace, the blast had to get through it, and it had to be burned sufficiently to act on the metal. The charge should go down in a steady gradual movement, and by having small charges that took place; with a heavy charge, as was the practice in some foundries, he considered that the coke ought to be of a good hard close nature in order to take the weight of iron. It was an open question whether they could get more heat from coke in a particular place in a furnace, or from having it mixed up with the metal. In their coke they got carbon 93.14, sulphur 0.56, ash 5.85, and moisture 0.45. He would like to hear what Mr. Harrison had to say about that. After all, it was a question of practice.

Mr. W. H. Sherburn asked Mr. Simkiss what size of cupola he used.—Mr. Simkiss: About 36 in.

Mr Markland said that, like Mr. Simkiss, he believed in light charges. His contention about heavy charges and great depth of coke, was that a quantity of it was burned away without any benefit; with 12 in., much of it burned away without doing any good. He used light charges and got the whole benefit of the heat. He believed also in using light coke.

The Chairman remarked that the point under discussion was whether light coke or heavy coke was the better for cupola work. Whether they charged light or heavy was a matter of practice.

Mr. Kay said he used a fairly light coke, but some he had had recently was extraordinarily light, in fact some of it was hardly fit to use. Heavy coke would be far better than that, of course, but his experience was that light coke generally gave much better results. He went into the question some time ago, and tried two of the best cokes, one rather heavy and the other a coke which would be called light rather than heavy. The latter proved undoubtedly to be the best, taking the quality of the metal brought out. They got more from it than from the heavy coke. Therefore, in his opinion, a moderately light or a medium coke was the best, being more economical in use and producing a better class of iron.

Mr. W. H. Sherburn did not think the question could be answered by a straight "yes" or "no," because the physical structure of the coke was a more serious matter than its weight and shape. It might be in heavy lumps, and though a good heat-giving coke, would not let the air pass through and give its heat off as it ought to do. The two qualities required were heat-giving and burden-bearing. A light coke might burn away fast, but it might also bear a good

burden. He thought the best was a light hard coke. The worst carrier might be the best heat-giving coke, and *vice versa*, but it was a question they could not answer offhand.

After a pause,

The CHAIRMAN said it seemed as though the question was too narrow to permit of a general discussion, judging from the silence which prevailed. His experience was that a medium, hard coke was the best. Some charged light scrap and others heavy scrap, and there was a variation consequently in the burden that had to be borne by the coke. Taking cupola practice as a whole, he believed that medium coke produced the best iron; medium coke of a good quality. He agreed with Mr. Simpkiss on the question of charges; with 12 in. of coke a great quantity of it developed into carbon-monoxide. Unless the charges were small and mixed well, continuous melting was not got, and unless continuous melting was got the results would not be good. Light charges were the most successful.

MR. BARNINGHAM said the coke he used came in very big pieces; it was a heavy coke, with a very dense structure. Foundrymen, he understood, generally asked for the silvery coke which burned rapidly.

MR. SIMKISS maintained it was all a question of practice. With regard to the structure of coke, it depended on the depth to which the ovens were filled before coking. When makers were pushed for deliveries, it sometimes happened that the coke was not sufficiently burned, and its quality depended chiefly upon correct burning. The more they knew of the art of burning the better would be the coke.

The CHAIRMAN said he did not know why Mr. Harrison had raised the question in the form he had done, since it had narrowed the discussion down to a fine point, as to what was the experience in the various foundries. They were first of all confined to the same exact chemical composition; and if they got the same composition they had not very much to fight about, because, whether they charged by bulk or by weght, unless they charged in a correct ratio to the charges of iron and the blast pressure, they would not get correct melting. It followed that whether they charged by bulk or by weight, they did not save very much, owing to their having to arrange the charges in the cupola in such a manner as to get correct melting. The use of coke in a cupola was, of course, to melt iron, and it had two functions to fulfil in doing that, to create heat and to stand sufficient weight or burden to keep the iron in the proper place for melting, *i.e.*, within the melting zone. There was a good deal of difference in the charging of cupolas, not only in relation to the amount of charge, but in the method of putting it on. The methods of two men might vary very much, so that practice had a great real to do with the question; and even if the two men carried out the same method under the same conditions, it would still be hard to give a correct statement as to which was the better coke, light or heavy. Mr. Harrison had told them that neither the carbon nor the ash had anything to do with the density of the coke. If that were so then it raised the question as to whether the lightness or heaviness of coke would make any difference in melting iron. They needed to have complete combustion of the heat-giving material, and a shortage of wind or air would alter the amount of iron melted with the same quantity of coke, whether light or heavy. The question of raising or lowering the bed by means of putting in 12 in., or 9 in., or any other quantity, brought them back again to the method of charging, so they were not very much nearer to a solution of the problem they were discussing. It was quite easy to assume that a medium coke gave the best results all round; in doing so, they were not binding themselves to one extreme or the other, because if they said medium was best that included a pretty wide variety. If they got different analyses they might find that one man's medium did not differ very much from another man's light, or from a third man's heavy coke. Mr. Sherburn came a little bit nearer when he said that the physical properties were more important than the weight. The physical properties decided what action the coke had in the furnace. It was a question whether the physical properties could vary with the same chemical composition.

MR. HARRISON, in replying on the discussion, said the physical structure of coke was entirely apart from the chemical composition, and, as he had mentioned before, neither carbon nor ash had anything to do with the physical structure. Mr. Simpkiss had supplied the only practical answer there was with regard to the different physical structures of coke, when he said that it depended upon the manner in which the ovens were filled up before burning. If the same coke were produced in the ovens under different conditions, it would differ in physical structure materially. The chemical composition had practically nothing to do with its physical structure. Mr. Sherburn said he did not think the lightness or heaviness had anything to do with it, while the physical structure had. But that was just the point; the physical structure decided whether it was heavy or light. There was a great difference between top cokes and bottom cokes.

MR. SHERBURN: You can have a light coke of a similar form to heavy, and similar composition.

MR. HARRISON: Of similar shape in the lump?

MR. SHERBURN: You can have two cokes which look alike, but are different in composition.

MR. HARRISON said the heat in the coke oven, and the temperature at which it was burned decided the composition. He was inclined to agree that medium coke was the best. In the analysis given by Mr. Simkiss, he supposed carbon 93.14 included the volatile matter, so there must be some volatile matter in it which had practically no heating quality. Mr. Markland spoke of the bottom coke burning away and doing nothing, but he could not see how the coke could burn without doing something. It was really mentioned in connection with 9 in., but he spoke of 6, 9, or 12 in., and when he said 12 in., it was simply that by taking a larger quantity they would get a difference in results.

MR. HARRISON, in reply to a question here interjected, said the difference in the heaviness of two cokes was caused by the difference in the porosity. The more air cells the lighter the coke. Ash content had nothing to do with the weight. A lump of coke was fuel plus air, and the heavier coke had less air space than the lighter.

The CHAIRMAN: It really seems like the old question as to which is the heavier, 1 lb. or lead or 1 lb. of feathers. Coke and open coke were perhaps the more correct descriptions. The lightness arose from its being more porous, and the heaviness from its being more compact.

The discussion then ceased.

A question next raised by MR. MARKLAND referred to a plate with a lip on it. It was 52 in. by 36 in. and the lip hung over by ¾ in. The plate in one secton out of 16 (cast iron) broke during an operation, and the speaker wanted to know the cause. It did not break during previous operations under exactly similar conditions.

MR. SIMKISS suggested that the crack was due to variations in contracting, and to the top lip not being sufficient to bear the strain.

MR. W. H. SHERBURN said the iron was poured in at one point, and the cooling began at the point furthest away from the runners: the portions near the runners cooled last and exerted a pulling force upon the

middle. Probably all the castings would be strained, though only one might break. The weak side would go first. They needed to equalise the place for cooling.

The CHAIRMAN: Are the runners exactly the same?

MR. MARKLAND: Exactly.

The CHAIRMAN said it was pretty evident the cause was a contraction strain.

MR. MARKLAND could not say as to that.

The subject then dropped.

MR. SIMKISS said he received an inquiry a short time ago for casting bosses on steel arms and rims combined. The foundry had to cast in the double solid boss. He was informed they were being so made or cast, and as he could not see his way out of the difficulty, he should be glad if any member present could give him the necessary information. He wanted a method of placing in the boss, the steel arms being already in the rim. The arms were staggered in the boss. He suggested a method, but it did not fit in with the ideas of the machine shop, which had the first say in the matter. There were 28 arms.

The CHAIRMAN had had experience with a somewhat similar class of article. He had cast bosses round arms that had been fixed to the rims, both single and double, and cast arms in bosses to which the rim had been attached afterwards. Generally they had made them in two halves, and occasionally they had made them solid. The two methods could be adopted, and the easiest, which was in general practice, was to alter the design slightly, and do away with the centre portion of the boss.

A brief conversation followed, but no solution of the difficulty was vouchsafed.

The CHAIRMAN announced that the annual dinner had been fixed for the second Saturday in January, the 11th, at the Victoria Hotel, Manchester.

The Grading of Pig-Iron.*

BY J. KAIL (Manager, Ganz & Company, Budapest).

Two methods are at present in use for estimating the quality of pig-iron and for grading it; the one depends upon the chemical analysis, and the other upon the appearance of a fresh fracture. Within the limits in which other elements occur in pig-iron these elements affect the appearance of a fracture in the following ways:—

Phosphorus and copper have no influence at all. Sulphur does not cause any change as long as its percentage remains below 0.1 or 0.12. Higher percentages of sulphur diminish the capacity for taking up carbon and diminish the separation of graphite (in pig-iron which is poor in manganese this effect of sulphur is noticed at lower percentages). The fracture assumes a finer grain, becomes dull and ash-grey. So high a sulphur content is, however, rare in pig-iron.

Manganese raises the capacity for taking up carbon, but it prevents the separation of graphite and favours the formation of a fine-grained fracture. The effects are the opposite of those of sulphur, but comparatively so small that the manganese content cannot be estimated from the appearance of a fracture.

Silicon counteracts the absorption of carbon, but it strongly favours the separation of graphite; the more silicon is present with a given carbon percentage, the more carbon will be separated as graphite and the coarser will be the grain and the greater the metallic lustre of the fracture.

* From a Paper read at the New York Congress of the International Association for Testing Materials.

It is thus carbon that is the element which is most strongly influenced by the presence of the other elements. With higher carbon percentages the separation of graphite increases, with lower carbon percentages it diminishes. But since the carbon contents do not vary so much as those of silicon (the usual limits are.—Carbon 3 to 4 per cent., and silicon 1 to 3.5 per cent.), the influence of carbon is relatively unimportant, and the appearance of the fracture does not admit of estimating the carbon percentage.

Silicon would then be the only element as to which conclusions can be drawn from the fracture. More correctly expressed, silicon is the only element which influences the appearance of the fracture to such an extent that the quality of the pig-iron can be judged from it. Even in this respect the estimation is unfortunately unreliable, since other factors also influence the segregation of graphite which is the chief factor for the appearance of the fracture.

When the pig is tapped from the blast furnace at a high temperature, it will, after cooling, display a coarser grain than when it was tapped at a lower temperature, presuming equal conditions of cooling. When the pig is rapidly cooled (as when it flows into metal moulds or when water is poured on it), the dissolved carbon in the molten iron will partly be fixed as hardening carbon, the separation of graphite will be small, and the grain will be fine. When the cooling is slow, on the other hand (as when the molten metal flows into sand), the graphite separation will be favoured, and the grain will turn out coarse. Thus it may happen, for instance, that a pig containing 1.5 per cent. silicon, slowly cooled, will show a much coarser grain than a pig with 2 per cent. silicon, rapidly cooled. In such cases the grading or quality estimation from the appearance of the fracture would be wholly misleading.

The percentage of graphite depends, as is well known, in the first instance upon the silicon content, and the silicon partly passes into the slag by oxidation. A higher percentage of silicon is hence an advantage, and in general such pig will be more valuable, since it can be mixed with cheap scrap.

The appearance of the fracture of pig is thus differently and oppositely influenced by the presence of various elements as well as by different treatments; to such an extent that the quality, so far as the silicon contents are concerned, cannot safely be estimated from the appearance.

It would, therefore, be desirable that this method of making an estimation from the appearance of a fracture—though certainly very convenient and expeditious—should be discarded as unreliable, and that chemical analysis should be exacted in its place.

A blast furnace is rarely tapped more than eight times in 24 hours, and an experienced works chemist can easily conduct 10 silicon determinations within three hours. It is hence possible to grade the output of the furnace of one day at very small cost with perfect accuracy.

In this field extraordinary want of system and confusion prevail at the present time. The various designations applied by different firms do not at all agree. The silicon contents of various kinds of pig, going by the same grade, differ, or more precisely expressed, the No. 1 quality pig of furnace A contains from 2.8 to 3.2 per cent. of silicon, while the No. 1 quality of B contains from 2.5 to 3.0 per cent., etc. If the estimation according to chemical analysis should be accepted, uniformity as to grading could easily be secured, for example:—

Pig rich in Si	Si above 3 per cent.
No. I.	Si 2.6 to 3 per cent.
No. II.	Si 2.1 to 2.5 per cent.
No. III.	Si 1.5 to 2 per cent.
Pig poor in Si	Si 1.4 per cent. and less

or simpler:

Pig No. I.	Si above 2.6 per cent.
No. II.	Si 1.6 to 2.5 per cent.
No. III.	Si 1.5 per cent. and less.

The Venting of Cores.

British Foundrymen's Association (Newcastle and District Branch).

A meeting of the Newcastle-upon-Tyne and District Branch of the above Association was held on Saturday, October 26, the Vice-President of the Branch, Mr. John Weir, of South Shields, occupying the chair.

The CHAIRMAN, in opening the meeting, said there had been some questions sent in for consideration which would probably give the members present food for discussion, one of which appeared to him to be very interesting, namely, "Can We Do Without the Venting of Cores?" Before discussing that question, however, he would like to announce the fact that classes were being formed for the coming winter in connection with the Association, and a useful and instructive series of lectures by Professor Louis at Armstrong College had been arranged.

Venting of Cores.

MR. HENDERSON said that the venting problem was constantly present, and gave a great deal of anxiety. In the first instance, he suggested, it was very largely a question of moulding sands; with a good sand from the point of view of venting, the founder could do with fewer vents than would be required with a sand containing a good deal of clay. He was convinced that a good deal of venting could be done away with by getting the right kind of sand. He had recently tried some experiments in connection with small cores, with a sand that was obtainable locally, and he had got good results without vents in cases where he had had difficulty in getting them with the ordinary Erith sand with vents. Probably most of them would know that there were products on the market which had for their object the doing away with vents. Some compositions that were offered, if used according to directions, practically meant that they could do without vents, but one of the difficulties in connection with them was the handling of the cores. He had seen cores made with one of those compositions, and found they were really good, and the sand did not take moisture; but one of the difficulties was in handling the cores green.

MR. GALLON said he had, with favourable results, tried cores without vents—heavy cores and heavy castings—but he would not like to say what it would do with a steam-way core where there was metal all round the core, and where the core was comparatively thin. In castings, for, say, rolling-mill work, where the cores were about 4 in. diameter, those cores could be cast in a mould like that quite easily. He had lately been making a large drum for a colliery; it was about $\frac{7}{8}$ in. thick in the body; flanges, 1 in.; diameter about 4 ft. 8 in. in the flanges; body, 3 ft. The man in putting those cores together and putting his top box on, got one of the holes that connected the vents with the top of the core just a little to one side, and the result was that he had to screw a spindle into the core to get a vent through. He screwed the spindle into the core all right, but he forgot to put a pricker down to make sure that the airway was clear up the spindle. The result was that the bottom of the spindle was choked with the dust, and there was very little air came off at the beginning. He (Mr. Gallon) saw that the air was not coming off, and he got a pricker and pushed it down the core so that what air there was came off very freely. If that had been made in the ordinary way they would have had a blow-up. Those cores were made from a special sand which had given good results so far.

MR. HENDERSON said a man had told him that in one shop where he had worked they used to make steam-way cores up to about 18 in. long, about half an inch thick by 2 in., and they never used any vents in them at all. Previous to doing that they had all kinds of trouble and a large percentage of bad castings. They used the sand that had been referred to with most successful results, and without having any vents at all.

MR. SMITH said he had recently visited a large foundry where jacketed cylinders were being made; the jacket ran right from the edge of the portway round the body of the cylinder, the latter being about 2 ft. 9 in. to 3 ft. in diameter, and about 18 in. deep. There was no vent in the core, but they just put a pricker down the prints, so that there was metal underneath, metal on the top, and metal in the sides. They never lost a cylinder while using that sand. That core was made of sea-sand and a composition now in the market.

The CHAIRMAN asked if Mr. Smith would risk one of those cores in a large cylinder.

MR. SMITH replied that he would risk it anywhere. It was an expensive composition, however.

MR. GALLON said he had seen sea-sand used with a mixture of molasses and flour with exactly the same result.

MR. PAULIN said the difficulty of handling green was an awkward one, and in light cores it was desirable to strengthen them with fine wires; they could support them with light, thin wires which would be easily drawn from the ports. Mr. Paulin said he had done some very intricate work with the patent composition mentioned, and had obtained most successful results with it. He had tried compounds of a gummy nature, and as soon as the outer skin broke away the core went, which was an objection, because moulders could hardly be prevented from rubbing cores even when they were light. As to the resistance of the cores to pressure, he had heard of one broad casting, an oblong shell, with a core which, owing to its area, was subject to a very heavy lifting effort, but it stood it all right. It would not be possible to do that with ordinary sand.

MR. ATKINSON said he had used the core composition in question, and the advantage was that irons in the cores could be dispensed with. He had cast box pistons up to 18 in. diameter with four cores in them. They had been accustomed to having irons in these cores, but with the core composition under discussion this was not necessary.

MR. SMITH said he had used two patent compositions, and had been satisfied with them both. He thought molasses was nearly as good if it was used in the right way.

MR. HENDERSON said he was at the present moment faced with a problem, and would like to hear if any of the members could assist him; that was how to do away with spindles. He found his men spoiled a lot of spindles, so that he had been trying to find a method of doing without the ordinary hollow spindle. He had an idea of using, instead of the ordinary spindle, a corrugated spindle of some kind. He

fancied the vent would travel along the corrugated spindle all right.

The CHAIRMAN said that the Americans made spindle cores as large as 12 to 18 ft. long, and as much as 18 in. in diameter. Those spindles were constructed with what were termed in the foundry "prods" of 1½ to 2 in. long; they used a composition which was put on like loam, which was of such an adhesive nature that there was no possibility of any of it dropping off. It was put into the stove and dried, and became exceedingly hard; it was of a porous nature, and when it was dry and put into the mould, the spindle was pulled out without any trouble at all. What the composition was he was not in a position to say. On the question of venting, he was still dubious about running the risk of casting a cylinder of 10 or 12 tons weight in the manner suggested by Mr. Smith. For instance, he used very light cores in some big turbines, in battle-ship work. The casting would, perhaps, be 45 tons. He would not feel justified in running the risk of perhaps a 30- or 35-ton casting with a light-built core made out of that composition.

MR. SMITH said one could get nothing as hard as the cores he had seen with the ordinary methods. He would never venture to make any core without putting irons in, however, because a portway core was very difficult to construct, and it meant a very big weight.

The CHAIRMAN said that apparently, with the evidence they had before them, it was possible to have cores without vents.

MR. GREENSITT said that in order to give the composition the most severe test possible, he took his knife and bored holes all the way down each side of a core until there was very little left when it was done with. He made a little mould, placed the core in the bottom with metal all round and over the top, and cast that. When he took the casting out, the core ran away perfectly. He had found a lot of trouble in drying the cores, the first being that when he did get one made and put it in the stove, one of the moulders would go and have a look at it, and put his fingers on it, and, of course, it collapsed. Then the next trouble was with some that happened to be too near the fire. When he picked them up they ran away. Those further from the fire were as hard as possible. He was afraid if they ever tried the patent composition on big cylinders, those cylinders would not be worth much, because he thought the core would melt away with the metal. It might stand light work, but he did not think it would stand heavy work.

Does the Placing of a Test Bar in any Particular Place Affect Results?

MR. MCLACHLAN said he thought it was a debatable point whether the placing of a test bar in any particular place affected results. For instance, in a turbine of, say, 20 tons, in the usual course the test bars were taken off the side, say two or three from each side of the casting. He thought in cases where the test bars were only taken from the side of the turbine in that way, it was not a test at all.

MR. HENDERSON said that his practice was invariably to get the test bar from the bottom, for the reason that one got most pressure there, and was likely to get a very solid iron. He thought that the further down the test bar was placed the better would be the results obtained. With regard to the size of test bars, he thought foundrymen ought to watch this, in order to get the test bar made as small as possible. He thought that was one of the things the Association ought to take up in the near future. There should be a standard test bar.

MR. SMITH said that before they dealt with the question of where a test bar should be cast, they should try to get to know why, if they cast six test bars on a casting (without a doubt the same mixture of iron going into those six test bars), and then took a ladle and cast two test bars separately, not one of those eight bars would give the same results. Whether they were cast on the bottom, on the top, or on the side, the differences were always there. In his opinion they would get the best results from the thinnest part of the casting. For instance, with a propeller, if a test bar was put within 4 in. of the propeller boss and another on the blade, in 99 cases out of 100 the better bar would be got from the blade.

MR. MCLACHLAN said that was just the point he had been wanting to get at. The one from the blade would be the best because the full pressure was got there, which was his contention from the beginning.

COUNCILLOR SMITH did not quite agree that the best part of the metal was at the top; he was rather of the opinion that the best part was at the bottom, if there was any difference at all, because any dross there was in the metal would certainly rise to the top. He thought the thinnest part of the casting was the best place to get the best results from a test bar, because the metal was of closer texture. There were fewer high-pressure cylinders condemned now since they had been case upside down than ever before. When the test was put upon them in the old days they invariably leaked round the top, which proved, he thought very conclusively, that the metal was sounder when the whole pressure of the iron was got on to the bottom. As regards the propeller blade, the bottom part cooled quicker, and a test bar placed there also cooled quicker. In the top part where there was 20 times as much metal, it took longer to cool, and, from his experience, the longer the test bar was in cooling, the weaker it was.

Titanium as a Deoxidiser.

According to a note on this subject in "The Iron Age," an interesting experiment was recently made to show the effect of titanium when used as a deoxidiser in steel. Two cakes of Bessemer steel were cast from two separate heats. One was plain Bessemer, and the other the same steel but treated with titanium. The composition of the steel in both heats was identical, the analysis being:—Carbon, 0.60 per cent.; manganese, 0.10 per cent.; silicon, 0.10 per cent.; phosphorus and sulphur under 0.040 per cent. The cakes of steel were flattened under the hammer from cones 2 in. high and 2 in. in diameter across the base and 1¼ in. across the tops. The cones were cast in small iron chills which were grasped by tongs and held under the stream of molten steel as it ran from the ladle into the ingot moulds. The cones were allowed to cool in the mould, then were re-heated and placed on the anvil of the hammer; a thin hooked rod was laid on the top of the cone and was welded to the latter by the first stroke of the hammer, forming a handle by which the cone could be steadied and turned under the blows, allowing both sides to be hammered equally. The cone of steel that was untreated with titanium cracked and split all around the edges, while the cone of steel treated with titanium did not exhibit the slightest tendency to crack, the outline of the disc being smooth and uniform. This fact is taken to indicate the degree of toughness and ductility the steel is given by the elimination of the oxygen and the oxides that are held in solution in the metal. The amount of metallic titanium required to effect this improvement was not more than 0.10 per cent., which was added as electrically smelted 15 per cent. ferro-titanium.

Brasses and Bronzes: with Brass-foundry Notes.

By H. L. Reason.

The opening meeting of the Birmingham Branch of the British Foundrymen's Association was held on Saturday, October 26, when Mr. H. L. Reason, Branch-President, delivered his Presidential address, in which he discussed "Brass and Bronzes; with Brass-foundry Notes." The address was as follows :—

The brass foundry is looked upon by people outside the trade as a business full of secret processes, and those interested are most reluctant to divulge any information concerning the inner workings; but I can assure you, there is no trade that would more appreciate any help likely to assist in the production of good, regular and sound castings. Iron-founders have their troubles, but I consider the brass-foundry problems are the most difficult. To give a man good materials and metal does not necessarily ensure good castings. When everything has been done to ensure the moulds being perfect in every way, the metal is found playing all the pranks imaginable. Careful mixing and melting are the watch-words of the brassfounder, for there is no doubt that the melting process is responsible for a good deal of his trouble. The metal is exposed in an open furnace, and although various methods have been, and are being, tried, the old-fashioned pit-fire-lift-out crucble furnaces more than hold their own for all-round general work; but I am looking forward to the electric furnace to solve a number of our difficulties.

After a short study of copper, one is astounded at its wonderful alloying properties. It is found that almost every known metal will alloy with copper, but against this splendid feature it is also found that it will absorb impurities in the same gluttonous manner, which involves the exercise of great care during the melting. The best castings are made when the metal is melted at the correct speed, and the castings poured at the right temperature, care being taken during melting, to prevent oxidation. If the following rules (an abstract from the "Brass World") were always carried out, we should have fewer waste castings :—

(1) Melt in such a way and with such a heat, that all the metal becomes liquid at about the same time. This avoids overheating or "burning" one portion of the metal before the rest has begun to melt. A moderate heat is preferable to a high one, even though the melting is a trifle prolonged, as it avoids overheating the exposed portion of the metal.

(2) Do not allow portions of the metal, such as ingots, or gates, to project above the top of the crucible. When this is done, such portions are overheated and "burned" before the bottom portions begin to melt. It is better to use less metal in the crucible at the beginning, so as to avoid this, and have all portions covered with charcoal.

(3) Warm the metal up before feeding into the crucible, after that in it has melted, so that it will melt more readily when introduced into the crucible. The metal may be warmed on the top of the furnace, and as long as melting does not take place, there is no gas absorption.

(4) Put some charcoal into the crucible as soon as the metal begins to melt, and add more from time to time if necessary, so as to keep the surface of the metal free from exposure. If a portion of the melted metal is exposed, then harm will result. A covering of charcoal to a depth of about an inch is usually necessary.

(5) As soon as the copper (if new metals are used) is melted, and has arrived at the righ heat, add the zinc, tin, lead, or other metals to be used. Far more harm results than with mixed metals, in allowing copper to remain melted for any length of time. as it absorbs gases so readily. This is why it is necessary to add the alloying metals to the copper so soon. It may be said in this connection, that this feature is one frequently overlooked by melters, and is responsible for much bad metal.

(6) Stir thoroughly after adding the alloying metals, and allow the rest of the metal to rise to the required pouring temperature. A good, thorough stirring is required for perfect mixing of the metals.

(7) When the right heat has been obtained on the metal, pour it into the moulds, and do not allow it to remain in the fire any longer than is necessary. Good castings depend upon this point.

(8) Do not allow the heat of the metal to rise far above the pouring temperature, and then cool down with gates and scrap. Metal that has once been overheated is injured, and cooling with gates or scrap, while reducing the temperature, will not overcome the injury done in overheating. Metal that has not been allowed to rise above the required temperature is always better than that which has been overheated and cooled down with gates.

(9) In conclusion, do not allow moulders to keep their metal in the fire while their heat is being put up. The moulds should be ready at the same time as the metal, or before. Better metal will result if the moulders have to wait for it.

The treatment of plumbago crucibles is an important item in the foundry. When crucibles arrive, they contain 4 to 5 per cent. moisture, and in consequence, require careful drying and annealing. Crucibles should never be put in core-ovens with wet cores, as they quickly absorb moisture. While it is true that if they are left in the stove long enough the moisture will be eliminated, it is a dangerous practice. It is a common practice to place crucibles over the top of the furnace to dry and anneal. If discretion is used, there is no danger, but to place a crucible over a very hot furnace will sometimes cause the crucible to scalp, or form an internal fracture which, after a few runs, commences to leak, and develop what is known as "pin-holes."

To anneal crucibles properly, an oven should be built using the wasted heat from the furnaces, and arranged so that the temperature can be raised gradually from zero to 250 deg. Fah. Crucibles up to 100 lbs. should remain in this temperature for 48 hours; larger sizes require more stoving.

The life of a crucible is considerably shortened by careless handling in the furnace. When the crucible is under melting heat, it is plastic, and, consequently, easily put out of shape with the tongs. As illustrating the damage done while lifting the crucible in and out of the furnace, in the case of tilting furnaces, where the crucibles do not have to be lifted in and out of the furnace, double the number of heats can be obtained from one crucible. It is a great mistake to leave crucibles in the furnace after the metal is ready for pouring. If this is carried on to any extent, the life of a crucible can be divided by two, and sometimes three.

Referring to the diagrams herewith, the figures on the right-hand side in all cases give the percentage of elongation, or, in other words, the amount the test bar stretched before breaking. The elongation, or stretch, is quite noticeable by the reduction of area and distorted wavy condition of the bar. In Fig. 1 it will be seen that the alloy 60 per cent. copper, 40 per cent. zinc, broke with 25 tons, and showed elongation of 50 per cent., *i.e.*, the 2 in. in which the fracture took place had stretched 1 in. The method adopted to measure elongation is to put two punch marks 2 in. apart on the test bar. After the bar has been broken, by placing together again closely, the amount the bar has stretched, or the elongation, can be emasured. If the 2-in. part of the bar has stretched to 3 in., this is exactly 50 per cent.,

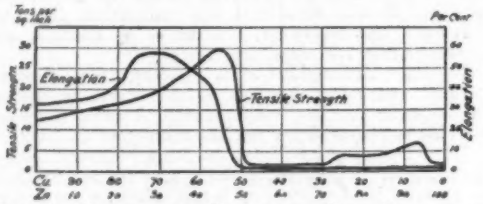


FIG. 1.—TENSILE AND ELONGATION TEST RESULTS OF COPPER-ZINC ALLOYS.

or ½ in. to the inch. The left-hand column on the diagram shows the load in tons per square inch at which the bar broke.

A short study of the diagram shown will give practically all the founder requires to know with reference to the physical properties of copper-zinc alloys. Commencing with 90 per cent. copper, 10 per cent. zinc, about 15 tons tensile and nearly 40 per cent. elongation is shown. The highest elongation is got with 70 per cent. copper and 30 per cent. zinc; consequently this alloy is used in rolling mills for sheet brass and brass tube. This metal is not suitable for the general run of cast brass, as it will not stand shock or strain. At the point where the lines cross, which is approximately 60 per cent. copper and 40 per cent. zinc, is obtained the best alloy for cast work. The tensile line is still rising, but the elongation line has commenced to fall. Both the elongation and tensile lines drop sharply before 50 per cent.

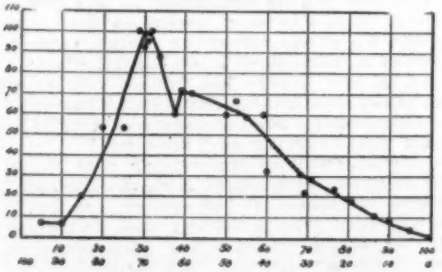


FIG. 2.—HARDNESS TESTS OF COPPER-TIN ALLOYS.

copper and 50 per cent. zinc is reached, and the metal becomes of the same strength as pure zinc. The tensile line shows a slight rise at 20 per cent. copper, 80 per cent. zinc, and 10 per cent. copper, 90 per cent. zinc.

Taking next the bronzes, the properties of these are largely governed by the percentages of tin. The recent market prices of tin are the highest on record, approximately 2s. per lb., with copper 9d. per lb. It will be readily seen that unless great care is taken with the use of tin, this will soon be a serious item in the foundry, and, as pointed out by Mr. H. S. Primrose in his Paper before this Association at the Cardiff Convention, an addition of 1 per cent. tin to an alloy of 90 per cent. copper and 10 per cent. tin, in a foundry turning out 20 tons per week, would cost £1,350 per annum.

Fig. 2 shows the hardness tests of copper-tin alloys, by means of the scleroscope, and the result of exhaustive experiments by Haughton and Turner. It brings out an interesting fact, viz., that standard gunmetal is very little harder than tin. Beyond this point (10 per cent. tin and 90 per cent. copper), the metal ceases to interest brassfounders. The 90 per cent. tin and 10 per cent. copper alloy is harder than gunmetal. The diagram shows that a very hard alloy can be got with 15 per cent. tin and 85 per cent. copper, an alloy with over twice the hardness of ordinary bronze, which is sometimes used in bearings.

Unlike the copper-zinc alloys, where the tensile and elongation lines run fairly well together, in the diagram (Fig. 3) of the copper-tin series, the elongation line is seen running away immediately. From a practical standpoint this chart is of little use to us beyond 90 per cent. copper and 10 per cent. tin, owing to the metal becoming too brittle. Although the tensile strength rises until the alloy 17½ per cent. tin and 82½ per cent. copper is reached, there is no

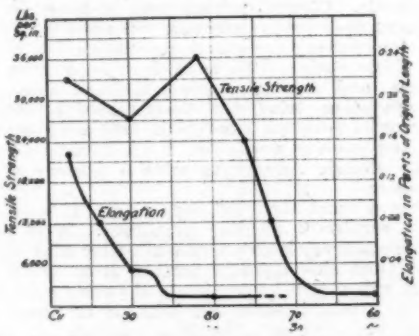


FIG. 3.—TENSILE AND ELONGATION TEST RESULTS OF COPPER-TIN ALLOYS.

elongation, or, in other words, a hard, brittle alloy is obtained.

TABLE I.

Cu.	Sn.	Zn.	Tensile tons per sq. in.	Elongation per cent on 2 in.	Cu.	Sn.	Tensile tons per sq. in.	Elongation per cent. on 2 in.
85	1	14	13.1	32	99	1	13.3	28
85	2.5	12.5	12.6	28	97.5	2.5	11.3	19
85	5	10	15.1	25	95	5	14.6	25
85	7.5	7.5	13.2	25	92.5	7.5	13.8	20
85	10	5	9.7	25	90	10	12.1	15

Table I. gives the test results of a series of test bars of copper-tin-zinc, and copper-tin alloys. In each case a commencement was made with 1 per cent. tin. Although the surface of one bar showed more signs of stress, the test results were practically the same. In the next instance, with 2.5 per cent. tin, a more tenacious alloy was got in the zinc series. This bar showed considerable surface effect, also reduction of area, due to its extra elongation. In comparing the next two bars, it will be noticed that although they give almost identical physical test results, the alloys are very different. The one having 85 per cent. copper would cost £100 6s. 8d. per ton, while the one with 95 per cent. would cost only £105 per ton.

In the next bars the physical properties were almost the same, the zinc alloy having 5 per cent. more elongation; and in the final two bars an appreciable difference is shown between the bronze and the alloy with zinc; the tensile strength has dropped considerably, the elongation remaining stationary. The outward appearance of the two bars was practically the same, but examination showed a steel-like structure with the bronze, which would give a much higher hardness test, and for fittings having to stand heat, would give the best friction surface.

TABLE II.

Cu.	Sn.	Zn.	Pb.	Tensile tons per sq. in.	Elongation per cent. in 2 ins
Per cent.	Per cent.	Per cent.	Per cent.		
85	1	12	2	11.1	20.5
85	2.5	10.5	2	12.3	22.0

Table II. illustrates the affect of lead in Cu-Sn-Zn bronze. Compared with the first alloy in Table I. the tensile strength has fallen 2 tons, and the elongation has been reduced to 20.5 per cent. There is a marked difference in the appearance, due to the reduction in elongation. In the bar with 2.5 per cent. of tin, the lead has not had the same detri-

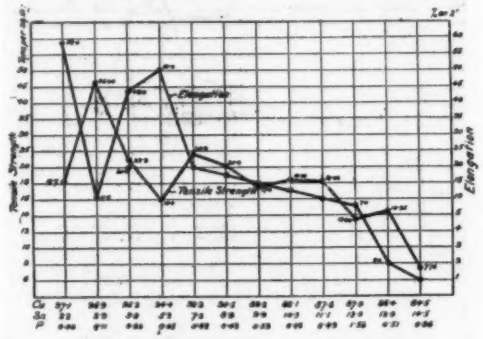


FIG. 4.—TENSILE AND ELONGATION TEST RESULTS OF PHOSPHOR BRONZES.

mental effect, but the elongation is reduced by 6 per cent.

TABLE III.

Cu.	Sn.	Zn.	Pb.
Per cent. 85	Per cent. 5	Per cent. 8	Per cent. 2
Breaking load in tons.	Breaking load in tons, per sq. in.	Elongation on 3½ ins. length, in inches.	Per cent. elongation.
9.87	13.2	0.58	16.58
10.07	13.4	0.615	17.56
9.80	13.1	0.57	16.39
9.57	12.8	0.48	13.71
9.80	13.1	0.48	13.71

Table III. shows the test results from a series of bars to British standard dimensions E. In conducting tests to meet British standard specifications, the bars have to be machined to a given size and definite length.

These tests show how regularly the figures come out with an alloy of the same composition. The first two bars were not cast from the same pot of metal, or at the same time, as the last three. I should say these results are better than would be obtained in ordinary practice, as these bars were cast from virgin metal, in order to obtain a true analysis. In the last two bars the elongation has dropped approximately 3 per cent.

Diagram, Fig. 4, showing the physical properties of phosphor-bronze was made from figures by the analyst at Woolwich Arsenal. Commencing with 18.7 tons tensile, and 58 per cent. elongation, with 0.4 phosphorus, a smart drop is shown in the next alloy, with phosphor down to 0.1 per cent. In the next two alloys, with 0.86 and 0.45 of P. the elongation is maintained. The next alloys are standard

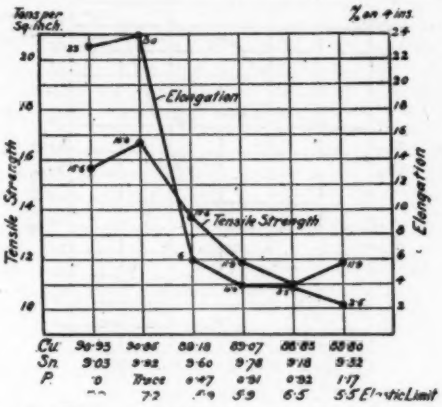


FIG. 5.—TENSILE AND ELONGATION TEST RESULTS OF PHOSPHOR BRONZES; BY GUILLET.

phosphor-bronze, and the tensile and elongation lines run well together. The most interesting feature of this chart is the difference of elongation in the second alloy due to the reduction in phosphorus. I consider phosphorus the best and safest flux available. It is not only a splendid deoxidiser, but it improves the metal, as shown by this chart, though it requires great care in using.

In diagram, Fig. 5, are shown results on phosphor-bronzes by Dr. Guillet, all practically the same alloy, showing how the addition of phosphorus brings down

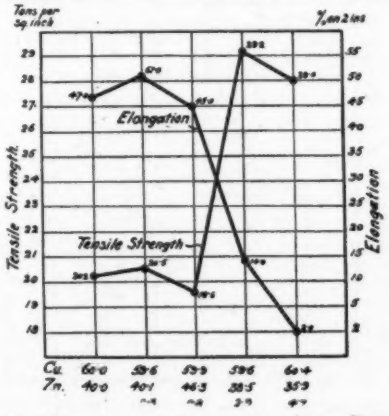


FIG. 6.—TENSILE AND ELONGATION TEST RESULTS OF 60-40 COPPER-ZINC-ALUMINIUM ALLOYS; BY GUILLET.

the tensile and elongation. The best results are obtained with just a trace of phosphorus, as in the second alloy. The third alloy should be found to be a good strong bronze, but the remaining three hard and brittle.

Diagram, Fig. 6, shows the effect of aluminium on a 60 copper and 40 zinc alloy. Up to 0.8 per cent.

the aluminium has reduced the tensile strength slightly, but at 2.9 per cent. Al. an increase in the tensile of 4 tons, and a sharp drop in the elongation of 36 per cent. are shown. Experience has shown that aluminium up to 2.9 per cent. assists in bringing nice, clean, sharp castings from intricate patterns, but it is not desirable for fittings to stand hypraulic pressure.

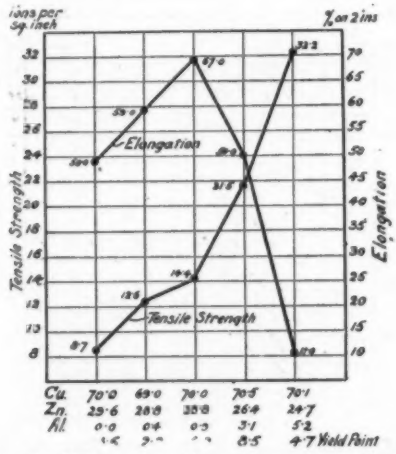

Tons per Sq. Inch
% on 2 ins
Elongation
Tensile Strength
Cu 70·0 69·0 70·0 70·5 70·1
Zn 29·6 28·8 25·8 26·4 24·7
Al 0·0 0·4 0·3 3·1 5·2
8·5 4·7 Yield Point

FIG. 7.—TENSILE AND ELONGATION TEST RESULTS OF 70-30 COPPER-ZINC-ALUMINIUM ALLOYS; BY GUILLET.

In the diagram, Fig. 7, is shown the effect of aluminium on a 70 copper and 30 zinc alloy. In this series the tensile strength rises to 32 tons in the last alloy, which contains 5.2 per cent. aluminium, the elongation, however, dropping to the danger zone. An alloy with 4 per cent. aluminium, would give a better alloy, which would give approximately 28 tons tensile and 30 per cent. elongation.

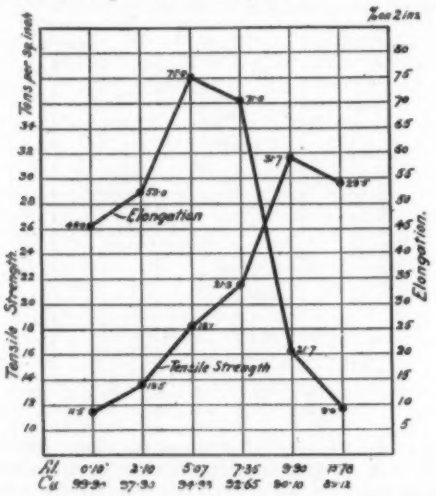


FIG. 8.—TENSILE AND ELONGATION TEST RESULTS OF COPPER-ALUMINIUM ALLOYS.

The advent of the motor and flying machines has brought about the extensive use of aluminium castings. Considerable difficulty was experienced with this metal until it was found that copper not only increased the strength of the metal, but rendered it easier to cast sound. In diagram, Fig. 8, is shown the Cu-Al alloys. The greatest elongation is obtained with 5 per cent. aluminium, with a slight drop at 7 per cent. With the addition of a further 2 per cent. the elongation falls rapidly. At the point where the lines cross, which gives approximately 27 tons tensile with 47½ per cent. elongation, the best metal for casting purposes is obtained.

Since my Presidential address of last year, in which furnaces were dealt with, the Buess oil-fired furnace (Figs. 9 and 10) has come under my notice. As regards construction, there are several interesting points. The top part can be swung clear very readily, as it is raised and carried by an arm. The burner it attached to the side of the furnace, and can be used to keep the metal hot whilst pouring. The cover, being in position whilst pouring, retains the heat and enables the burner to be kept going.

In Fig. 10, the pre-heater is shown raised, and the crucible in position for warming. As is well known,

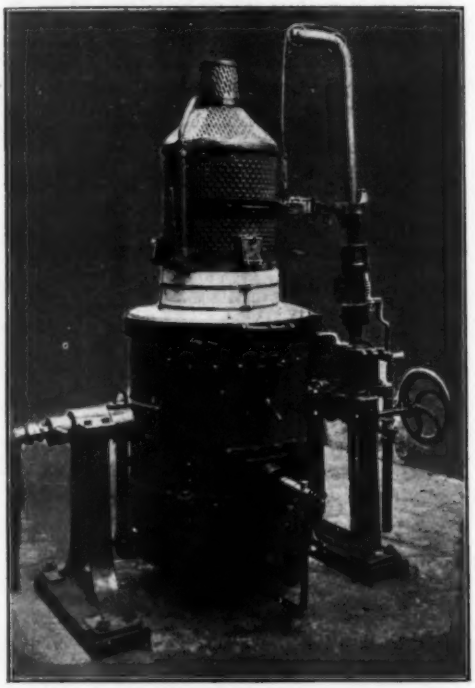


FIG. 9.—BUESS OIL-FIRED FURNACE FOR NON-FERROUS ALLOYS.

it is essential to use hot ladles in conjunction with tilting furnaces to keep the metal hot.

The air pressure required with this furnace is 15 lbs. per sq. in. This is much lower than the majority of furnaces work at, but I think it would be better if the pressure was lower still. The air is admitted and passed through the trunnion and into the receiver, which answers three purposes; it keeps the bottom of the furnace cool, raises the temperature of the air to 400 deg. Fah., and in passing through the oil chamber warms up the oil. By this means a hot oil and a hot blast are obtained, so that the flame is much more intense than when using cold air and oil.

A tap hole is provided, so that in the event of a crucible breaking the metal can be run off without

damage to the furnace, the burner keeping the metal in a molten state meanwhile. The flame strikes the pedestal and obviates damage to the crucible.

The speed of melting, according to results, from a furnace in actual use at Huddersfield, is 45 minutes per cwt. of phosphor-bronze, using ingot metal. The oil consumption is 9 lbs. of crude creosote or tar oil per cwt.; average life of crucibles in 4-cwt. furnaces is 30 to 40 heats. The linings will last 600 heats.

Fig. 11 shows a view of three furnaces fixed.

In conclusion, I should like to thank Mr. Parsonage, of this school, on behalf of this Association, for his unfailing kindness in carrying out the necessary tests.

Discussion.

Mr. Heggie, in opening the discussion, remarked that he did not agree with the President that there

Fig. 10.—Buess Furnace, with Pre-heater shown Raised and Crucible in Position for Warming.

were more difficulties in the brass foundry than the iron foundry. They in the iron foundry were disposed to think that their friends in the brass foundry had no difficulties at all; but Mr. Reason had given them a vast amount of information which must be of the greatest value to brass founders. Although it was a Presidential address, discussion was invited.

Mr. H. Pemberton (Derby), in the course of a lengthy speech, said that the President had given them quite a lot of food for reflection. The melting of the alloys was a delicate business, and there was a need of much freer discussion and more interchange of thought between brass founders. He agreed that metal should not remain in the fire any longer than was absolutely necessary, but it would help them very much if Mr. Reason could give them the approximate length of time which he considered suitable for, say, per 100 lbs. of bronze. He (Mr. Pemberton) had a few figures dealing with experiences in connection with an oil-fired tilting furnace. He found that, roughly, the cost of melting metal was about 10.5d. per 100 lbs., including labour, fuel, and cost of pot. The amount of oil used was about one gallon per 100 lbs. of metal melted. Mr. Reason had given them the amount in lbs., but it would be much more convenient if stated in gallons, because oil was measured and not weighed; but if an oil-fired furnace without a pot were used, it would require 2.5 gallons per 100 lbs. of metal, or an increase of 150 per cent. With a coke-fired furnace the cost of melting 100 lbs. came out at 16.2d. per 100 lbs. of metal. That was in an ordinary 120-lbs. pot. For that amount 33 lbs. of coke was used. He had recently seen in Birmingham a high-pressure gas melting furnace, with which he believed Mr. Reason was acquainted, and would like to have his opinion upon it. He (the speaker) found when taking the results the cost of melting 100 lbs. of metal was 23.7d., which compared with the 10.5d. for the oil-fired pot furnace. The gas consumed was 875.2 cub. ft., taking the average gas pressure as shown by 22.8 in. of mercury. As to the length of time for melting in the pot, he found, in practice, with an oil-fired furnace and using a 600-lbs. pot, that 12.5 minutes per 100 lbs. of metal was sufficient. With the oil-fired furnace and using 2.5 gallons of oil per 100 lbs. of metal, 10 minutes only was required. In that case the metal was exposed to the fuel, but it was not at all advisable to melt in that way. With a coke-fired furnace and employing a pot of 120 lbs., the time required was 66 minutes per 100 lbs. That was certainly the outside limit of time, and if the metal stayed longer than that it became sticky and absorbed gas, and if nothing was found wrong with the castings while they were in the foundry, when they got to the machine shop often they would be found to be full of pinholes. Undoubtedly this was due to the metal remaining in the furnace too long and absorbing gas from the fuel. In melting metal, Mr. Reason had stated, it was not advisable for metal to lie over the side of the pot. He quite agreed that that was very detrimental, but he would like to have had more information as to the amount of loss in melting, because in connection with brass-foundry work this was a most important point. In melting alloys it was always advisable to melt the copper and brass together, for the reason that copper when melted alone had a great affinity for oxygen, and therefore oxidised very rapidly. The oxide of copper did not come to the surface, but was held in suspension in the molten metal, and it could not be got out unless a very good deoxidiser were used. Therefore it was better to melt the copper and brass together, because brass contained zinc, which acted as a deoxidiser, and as the brass melted first this formed a covering for the copper and prevented it being oxidised. He would like to know what Mr. Reason considered a fair percentage of loss in workshop practice. In the laboratory and with high-pressure gas, the loss per 100 lbs. of metal was about 1 per cent. in an 80-20 alloy.

Another point Mr. Pemberton dealt with was the presence of moisture in crucibles through absorption. It was perfectly true that a crucible wanted very careful handling. Mr. Reason had suggested the building of an oven in which to place the crucibles. He (Mr. Pemberton) did not consider that necessary. It was better to place the crucibles on a shelf or rack near the flues of the furnace. It was possible to keep them always warm and at a steady temperature. It was a very common thing for crucibles to absorb moisture. He had known cases of crucibles being wet, even

when they had been in the foundry for at least a fortnight, and that would often happen in the winter in the month of November when the weather had been very foggy. When a damp crucible was put on the fire, an explosion occurred, spoiling the crucible. The greatest care should be exercised in their treatment. The President had given them among his bronzes a 90-10 copper-tin alloy, with which he did not use anything as a deoxidiser. He (the speaker) would like to know if anything else was used except charcoal. They were no doubt aware that this mixture, without any zinc or even phosphorus, required very careful melting to secure a good sound casting. Referring to other alloys, it was most useful for them to know that by a slight alteration of metal, without impairing the result, it was possible to save £5 per ton. He quite agreed with Mr. Reason also that the effect of lead reduced the strength of bronze. He would be glad to have some idea of the wearing properties of these bronzes.

FIG. 11.—VIEW OF THREE BUESS FURNACES, SHOWING BURNERS IN OPERATION.

If an alloy was to be used for bearing metal it was a well-known fact that the addition of lead improved it, because lead in itself was a great lubricant and a non-conductor of heat. Consequently, it was the greatest anti-friction metal at present known. The lead was extremely valuable and improved the metal, so long as the elongation and tensile strength were not reduced, but they would like a little more information as to wearing properties of the bronzes given by Mr. Reason.

In the phosphor-bronze group, continued Mr. Pemberton, Mr. Reason had spoken of phosphorus as being the best flux that he knew. He quite agreed as to its excellent qualities. They were told that the best results were obtained with what was called a "trace" of phosphorus. He would like to know exactly how much phosphorus was put in to that mixture of 90 per cent. copper and 10 per cent. of tin to give just a trace in the finished casting, and also in what form it was introduced. In regard to the use of aluminium, he did not think it desirable to use aluminium in brass-foundry practice to get sharp castings, because aluminium had a great affinity for oxygen, and produced porous castings to a greater extent than anything else he knew. It should be avoided unless they were making aluminium-bronze. He would like to know what was considered the best flux when using aluminium. He personally had found, both for aluminium casting and for aluminium bronze, that chloride of zinc was the finest flux. The proper way was to put a small bit of chloride of zinc on the top of the metal, when it would dissolve in the aluminium oxide and give the metal a watery flow and produce a sound casting. In regard to copper-aluminium alloys, very low elongation was got with 9.9 aluminium and 90 per cent. of copper. He believed that Professor Carpenter and Mr. Edwards in the Alloys Research Report to the Institution of Mechanical Engineers, on aluminium-bronze, recommended that very alloy, and stated that 10 per cent. of aluminium with 90 per cent. copper formed one of the strongest alloys known for withstanding high pressure. That resistance to pressure was a point not dealt with by Mr. Reason. To him (the speaker) the Buess furnace was new, and he would like to enquire as to the effect of the gas being blown into the pot which was in the pre-heater, and whether it was found that the pot shelled at all with being hot on the inside and rather cold on the outside; also whether it would not be better to put the pot in a coke-fire rather than in the pre-heater of the furnace. He was inclined to think that the pot would shell through expansion. Very interesting information was given as to the lining. In one case a lining lasted for 600 heats. He would have expected that it would have lasted a good deal longer. He knew

a case of an oil pot-fired furnace in which a lining was said to have lasted from four to six months with about 8 heats per day.

Mr. T. G. Donson (Bordesley) said that in regard to getting 30 heats out of 400-lb. crucibles from those tilting furnaces with forced draft, his experience with them for over eighteen months was very different. The largest number of heats he had obtained was ten, but very often he got only five or six. The furnaces were fired with coke. He also had two small oil furnaces, with 120-lb. crucibles, and these were more satisfactory. The crucibles produced 16 to 18 heats, melting copper and gunmetal, and he was able to melt 100 lbs. of gunmetal every 20 minutes.

Mr. H. L. Reason, replying to the discussion, said that the time for melting metals in a well-designed pit-fire lift-out crucible furnace with natural draft, would be 40 minutes for gunmetal and a little less for brass. The speed of melting, being the same for the different size crucibles was accounted for by the increased coke space in the larger size furnaces. As to the weight and measurement of oil, 9 lbs. of oil were equal to about three-quarters of a gallon. The low oil consumption in the Buess furnace was accounted for by the oil and airblast being heated, which gave a more intense heat. With reference to the high-pressure gas furnaces he had seen under test at the Birmingham Gas Works, he understood a number had been fixed in Birmingham. From the information gathered, they were most successful on aluminium. He saw a trial run on strip brass casting when the speed of melting was rather slow, and the gas consumption came out more expensive than coke. Better metal was obtained owing to being melted in a reducing atmosphere, and the losses of metal in melting were low. The 90 Cu.-10 Sn. alloy was difficult to cast sound, and to obtain good results it would be necessary to add a little phosphorus. The method of adding phosphorus was in the form of 10 per cent. phosphor copper, one half-pound tablet being enough for 100 lbs. of metal. It should be added just before the crucible was drawn from the furnace. If added too soon, the benefit of the phosphorus would be lost. As to the loss of metal in actual practice, this depended upon the care exercised by the workmen, and the nature of the metal used. In the case of light scrap the percentage of loss would be greater than when using ingot metal, but from 3 to 4 per cent. should be sufficient for brass when using ingot metal and heavy scrap, 2 to 3 per cent. for gunmetal, the latter being lower owing to the reduction of zinc in the alloy. Except for bearing metals, lead was very detrimental. The object of adding lead to brass and bronze was to make the metal easier for machining. The best results were obtained with 2 per cent. lead; over 3 per cent. trouble would be experienced owing to segregation. For friction purposes, such as bearings, lead was required to obtain a good anti-frictioned surface. Where high lead alloys were used, the castings were made in chills as it was necessary to have rapid cooling to prevent the lead oozing out of the metal. As to an aluminium flux, he had had no practical experience, but he should think Mr. Pemberton would obtain good results with chloride of zinc. As to Mr. Dobson's experience, it must have been very expensive to only obtain ten heats from one crucible. He could only attribute this to bad furnace design. The cutting away of the crucible on the bottom part was probably due to an excess, or a sharp cutting heat, in this part of the furnace. In conclusion, Mr. Reason expressed thanks to the London Emery Company for their kindness in supplying the lantern slides.

"F.T J." Bookshelf.

The Technology of Iron Enamelling and Tinning.

By Julius Grünwald. Translated from the German by Herbert H. Hodgson. London: Charles Griffin & Company, Limited, Exeter Street, Strand, W.C.

Dr. Grünwald will be remembered as the author of "Enamelling of Iron and Steel." reviewed some months ago in our columns. He is recognised as an authority on enamelling, and so far as that subject is concerned, the present volume is of unquestionable value. Opening with a brief historical and economic survey of the subject, he proceeds to the chemical technology of the enamel industry, following with an article on enamel manufacture and the function of clay in enamel. A brief but very instructive chapter deals with the theory and technology of "purple of Cassius," which plays so important a part in the colouring of ceramic work, and then the writer proceeds to other phases of enamel preparation. The heating and pickling of rough iron wares forms the subject of a chapter of practical interest, while useful informtion is given regarding the calculation of the chemical composition of an enamel from the mixed raw materials. The addition to the foregoing of chapters relating to the tinning industry is by reason of the fact that the majority of enamel firms also engage in tinning. On this subject, however, the author is rather too brief. The recovery of tin from tin waste is dismissed in less than half a dozen pages, and the tinning itself is given very little more attention; but since enamelling is the trade mainly appealed to by the book, the other portion is acceptable as an introduction to the subject of tinning, though it can by no means claim to represent the importance of the tinning industry.

Notes on Foundry Practice.

By J. J. Morgan, F.I.C., F.C.S. London: Charles Griffin & Company, Limited, Exter Street, Strand, W.C.

A useful little volume has been added by the author of this book to the minor works on foundry practice. The book occupies only about 100 pages, but summarised the important matter relating to both the practical and the scientific side of the foundry work which is to be found in detail in more extensive works. A number of well-known standard works have been drawn on for the in formation, which is presented in clear and concise form. As a foundry text-book it is rather too brief, but should be found very useful for engineering students and others who desire to have the work and requirements presented in a concise form.

The Chart of the Elements.

London: The Metallic Compositions Company, 265, Gray's Inn Road, W.C.

This interesting and useful publication consists of a chart 40 in. by 34 in., giving a descriptive bird's-eye view of every metal and non-metal which is known to exist, either combined or free, showing all the most important properties and constants which each possesses. The elements are arranged upon the chart according to the "Periodic Law," so that not only are the properties actually given available to the reader, but some idea may also be gleaned of the probable nature of the properties not yet known. The chart forms, therefore, a classification of the metals and non-metals which will prove very useful.

Lehrbuch der Eisen- und Stahlgiesserei.

By Bernard Ossann, Leipzig: Wilhelm Englemann.

In this handbook of iron and steel founding the author, who is a Professor at the Royal Mines Academy, Clausthal, has presented an excellent survey of German and also contemporary foreign foundry practice, plant and works equipment. It is compiled on lines which make it suitable for the practical worker, the manager and the engineering student alike. In dealing with the scientific side of foundry work, the researches and experiments of American, British and other investigators are freely drawn upon, while in the matter of foundry equipment attention is by no means confined to German practice. The cupola (its construction and operation), is treated with commendable fullness, and much of value is presented regarding air furnaces. The composition and constituents of pig-iron, and the various phenomena associated with its use in the foundry are discussed at length, and the author then proceeds to other phases of the subject such as the testing of castings, etc. The practical side of foundry work, moulding, melting and pouring, receives full consideration and a number of different classes of moulding jobs are described and illustrated. Careful consideration is given to the materials employed, particularly moulding sand. On steel foundry practice, while the treatise is not exhaustive, it is acceptably instructive, particularly in view of the scarcity of literature on steel founding. The book throughout is well illustrated, and several useful large diagrams show typical foundry lay-outs.

Probenahme und Analyse von Eisen und Stahl.

By Prof. O. Bauer & E. Deiss. Berlin: Julius Springer, Linkstrasse 23-24.

The authors, from their extended experience at the Royal Testing Laboratory, have presented a very useful handbook and guide for use in iron-works laboratories. In the first part Prof. Bauer deals with the examination of iron and steel, discussing first the arrangement of a metallographic laboratory for testing and analysis, and proceeding to the knowledge of metallography necessary to iron and steel examination. Discussions on different classes of iron and steel, their characteristics and the methods of microscopic examination complete this part of the book. In the second part E. Deiss treats with the analysis of iron and steel. This section should prove very useful, as not only are the elements carbon, silicon, manganese, phosphorus, sulphur, copper, and arsenic dealt with, but special consideration is given to the rarer constituents, such as nickel, cobalt, chrome, aluminium, titanium, wolfram, vanadium, molybdenum, and oxygen. The whole forms a volume which should prove very acceptable to laboratory workers in the iron and steel industries.

Modern Copper Smelting.

By Donald M. Levy, M.Sc., Assoc. R.S.M. London: Charles Griffin & Company, Limited, Exeter Street, Strand, W.C.

All foundrymen dealing with brasses and bronzes should be interested in modern processes of preparing the chief raw material of the brass foundry, as the success of the work is so largely dependent on the quality of the materials employed. In the volume before us, which is based on lectures delivered by the author at Birmingham University, is given a concise survey of modern copper smelting practice. The practice of some of the best organised smelters and refineries in the United States of America is represented in the book, which may thus be accepted as a reliable modern guide to the subject. A brief survey of the history and uses of copper opens the book, followed by a summary of the compounds of copper, varieties of commercial copper, ores and their preliminary treatment and sampling. The next chapter gives a rapid survey of the various processes of preliminary treatment of the ores—concentration, briquetting, sintering, and roasting. Here the development of the roasting furnace is outlined. Reverberatory smelting practice and blast-furnace practice are in turn next dealt with, and here the author carefully outlines the principles and gives details and illustrations of the furnaces and other apparatus employed. Particularly as regards blast-furnace practice, a number of typical modern installations of plant are cited and illustrated, the subject in all its aspects receiving careful attention. The Bessemerising of copper mattes is similarly treated, and the final chapter deals concisely with the purification and refining of crude copper. The book, while not an exhaustive treatise on copper smelting, presents a very acceptable survey of modern practice, embodying much useful information on each phase discussed. Above all, it places before the user of copper a clear exposition of methods of production which should prove very valuable to the brassfounder and other workers in the copper alloys.

Commercial Engineering.

By A. J. Liversedge. London: Emmott & Company, Limited, 20, Bedford Street, W.C.

This is not an engineering text book, nor a compendium of commercial information, but a concise and readable exposition of the commercial aspects of engineering businesses. Both the highly-trained technical man, on his introduction to business affairs, and the essentially practical man, on his promotion to management, invariably feel somewhat at a loss. They are conscious that there are aspects of the situation outside their previous range. The organisation of works production, office routine, buying and sales departments, and the economical equipment and conduct of each, necessitate a wide and comprehensive knowledge of materials and their cost, arrangement of buildings and space, management of men, analysis of accounts, home and foreign markets, company law patents etc., to mention only part; and an accurate co-ordination of that knowledge is difficult to acquire, even given the capacity, and the information required is rarely ready to hand. This work is designed to supply just that information, and it very effectively bridges the gap between purely commercial and technical capacity. It is neither exhaustive nor abtruse, but useful, and the reader requiring further information on any matter touched will generally find the easiest access to such information indicated. We can recommend the book to all engaged in any branch of management and conduct of an engineering business.

The Termagon Process of Art Castings.

Before the recent Convention of the German Foundrymen's Association, Herr Max Küller described the method of using the moulding material used in the Pergamon process for art castings. This material in cooling changes from the liquid state to an elastic condition, and then solidifies. It is poured on to the covered pattern, from which it can be detached when the elastic condition is attained, and only needs to be well dried to be ready for casting. The preparation is in the form of powder, which merely requires to be stirred up with hot water until a homogeneous mixture is obtained, which is used for pouring on to the patterns in a lukewarm state, and furnishes moulds which reproduce all the details of the pattern with accuracy. The process is said to be applicable for making castings of nickel (25 per cent.) aluminium, zinc, etc., iron being the only metal with which any difficulty is encountered.

Making Flange Pipes Vertically Cast in Loam, without Disturbing the Brickwork.

By Sidney G. Smith.

From a point of economy it is not wise to make a pattern and the necessary accompanying tackle to cast a small number of large flange pipes vertically; it is cheaper to make them in loam than in sand. If the number of castings required is 10 and the diameter is anything between 30 and 60 in., the method here described should be economical.

The left half of Fig. 1 gives a sectional view of the assembled mould and tackle. A stock box should be selected which would allow the thickness of a whole, or split brick on either side, with the usual allowance of ¾ in. of loam. If the length of

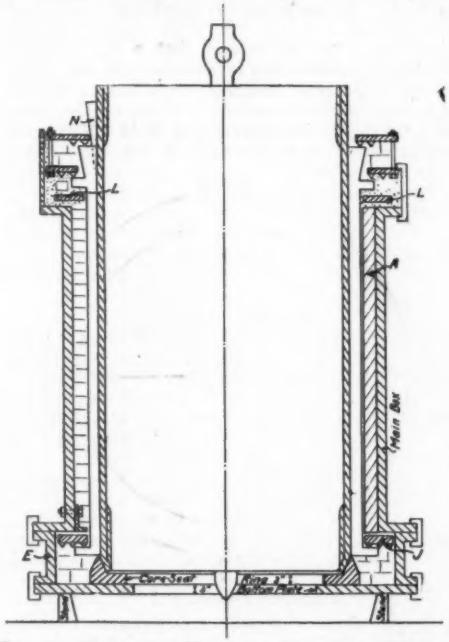


Fig. 1.—Sectional View of Assembled Mould.

box is too short, it may be made up with matching pieces bolted or cramped together. The boxes are longitudinally in halves. A thin narrow flange is made and fixed in both sides lengthwise, down the joint of each box (A, Figs. 1 and 2). A thin flange (see B, Fig. 3), is also carried around the bottom of each half box. When once bricked up, these flanges keep the brickwork intact, and a large number of pipes can be made with the permanent brickwork. In commencing, the procedure is as follows:—Level a suitable bottom plate (Fig. 1) upon stands or bearings, with provision for a rail or bar for the mould-board spindle (see Fig. 2). Put the bottom ring box E on the bottom plate, and also the core-seat ring shown. Plumb with line from the centre of the spindle plank to the centre of the spindle bar at bottom. The mould board when correctly set to size sticks may be put in for bricking and striking the bottom flange at the finger H (Fig. 2). The mould board being taken out for drying the bottom flange, the finger H is unscrewed and taken off the mould board.

In this method the cake plate which covers the bottom flange is split in halves by means of a flat core, as usual, and held together by means of fish plates; but instead of being bolted together in the usual way, in this case the holes are drilled and tapped, and the plate is held together by set screws through the fish plate (see Fig. 4). When the cake plate has been struck up, dried, and put into its proper position on the bottom flange, the set screws are taken out and the fish plates removed in order that they will not foul the narrow flange which carries the permanent brickwork in the main box. For obvious reasons there are no staples cast in this cake plate, as they would foul the main box; hence the plate is turned over with a small hook chain,

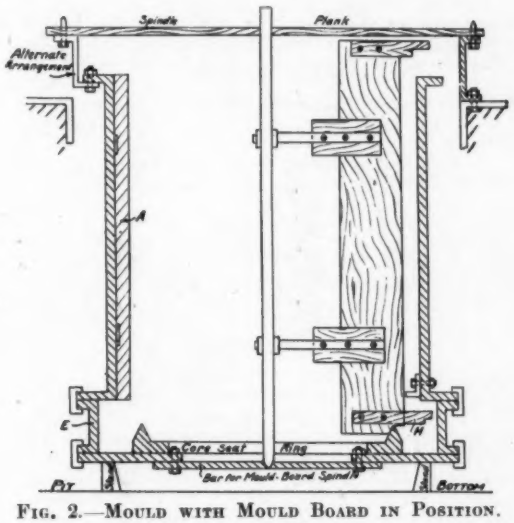


Fig. 2.—Mould with Mould Board in Position.

through two of the holes shown in Fig. 4. It is then slung by three hooks, as sketched in Fig. 4, on the outside edge of the plate, a little loam being removed for that purpose. When placed in position on the bearings of the bottom flange and centred, half of the main box is hoisted up with a two-legged chain and slung with eye bolts which pass through the top flange of the main box, so divided that it will sling level (see Fig. 5). The half-box is set to the square guide pins which are fixed in the bottom box or ring (see Fig. 6); the boxes in halves are set up to the pins, not over them (see also Fig. 3). When the boxes meet they are cramped or bolted together, also to the bottom box or ring (see Figs. 2 and 6). Bricking bedded to the boxes is then carried up to the level of the top flange of the main box, or about 4 in. below the top flange of the pipe (see left-half of Fig. 1), leaving that space for a plain ring or plate, which is in halves (L, Fig. 1) to carry the top flange. When the brickwork is complete.

and dried with pan fires, it is roughed with loam, and struck up with finishing loam, and again dried with pan fires, afterwards carded, blacked, and sleeked off with the trowel. After the body core,

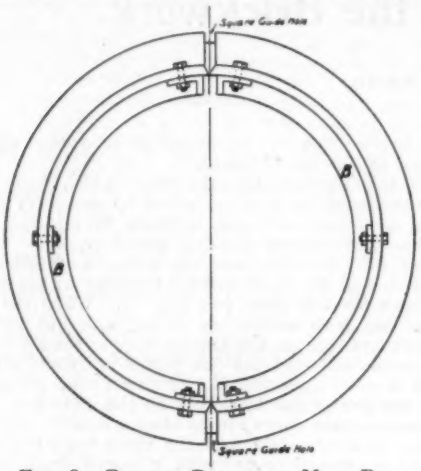


FIG. 3.—PLAN OF BOTTOM OF MAIN BOX.

which is in this case a partly collapsible barrel, is lowered in and centred, the head part which forms the top of the flange and closes in the mould, made

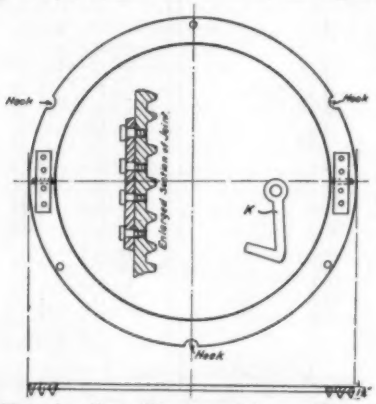


FIG. 4.—CAKE PLATE TO COVER BOTTOM FLANGE (J., FIG. 1).

as described in former articles, is lowered over the body core which centres it, and is cramped to the top flange of the main box, after which a wrought-

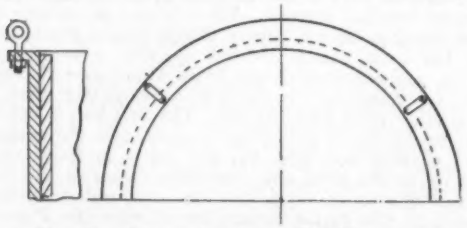


FIG. 5.—ARRANGEMENT OF EYE BOLTS FOR LIFTING HALF BOX.

iron ring is passed over it with an inch or two space left for ramming black sand to prevent the brickwork of the head from bursting.

The runner, or pouring box, should not be less than 6 in. deep, and the width from the body core about the same. Such a runner box is generally made from sheet iron of 3-16 or ¼ in. thick. Flat runners should be used where there is a top flange as shown at N (Fig. 1). Although the runners enter at the top of the head, flat ones are preferable to

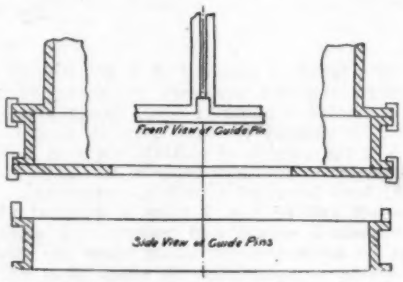


FIG. 6.—FRONT AND SIDE VIEWS OF BOX, SHOWING GUIDE PINS.

round ones, for the reason that a flat runner filed into the top cake plate is parallel with the body core and has a straight fall, whereas if round runners are used, they come nearer the outside of the head top, and probably beat against the body core or mould, causing splash shots to lodge in the top flange, and

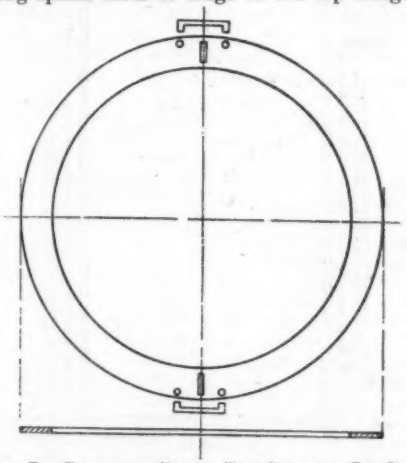


FIG. 7.—PLATE TO CARRY TOP FLANGE (L., FIG. 1).

possibly causing the core or mould, or both, to scab or suffer from excessive errosion. This is illustrated in the sketch, Fig. 8.

After the casting is poured and set, the runners removed, etc., the core which is on a key barrel is

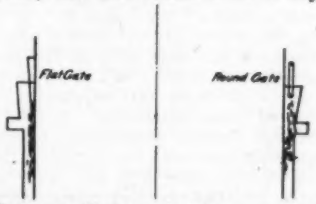


FIG. 8.—SHOWING EFFECT OF FLAT AND ROUND GATES.

liberated. After this, to allow for contraction lengthwise, the plate or ring (Fig. 7), which is in halves, is removed, to allow the casting plenty of freedom to contract.

When the casting is being stripped, after the cramps or bolts are liberated, the eye bolts are placed in one-half of the box and that is lifted away. After the other half is removed, the casting is free for lifting away; the boxes are then replaced as explained, and another pipe proceeded with.

Referring back to Fig. 2, on the left-hand side is shown an alternative plan of fixing the spindle plank to the box by means of a bracket which has a pin fixed in it for the plank and a hole to bolt to the flange of the box. This is convenient, because it can be removed and replaced with little trouble, and makes the box independent of the pit side, no stoops or stands being required.

British Foundrymen's Association: Branch Programmes.

Birmingham Branch.

December 7.—General discussion.

January 25, 1913.—"Specifications for Foundry Pig-iron, Part II.," by W. B. Parker, F.I.C., Rugby.

February 22.—"Moulding a Crank Case for a Four-cylinder Vertical Gas Engine," by J. G. Robinson, Halifax.

March 8.—Discussion on "The Practical Effect of Carbon on Iron as Viewed from the Equilibrium Curve of Iron-carbon Alloys"; to be opened by G. Hailstone, Carnegie Research Scholar.

April 26.—"Some Further Notes on Moulding Sands," by J. Shaw, Dudley.

Meetings are held at the Technical School, Suffolk Street, Birmingham, at 7 p.m.

Halifax Branch.

Dec. 14.—"Mishaps and Recoveries; a Practical Paper," by J. Gaunt.

Jan. 18, 1913.—Discussion on Foundry Problems, and annual dinner.

Feb. 15.—"The Production of Sound Castings," by R. Buchanan, Birmingham.

March 15.—"Introduction to the Microstructure of Iron and Steel," by E. W. Smith, B.Sc.

Feb. 12.—"Moulding Procedure in Loam," by S. G. Smith, Chesterfield.

Meetings are held in the Municipal Technical College, Hopwood Lane, Halifax, at 3 p.m.

Lancashire Branch.

December 7.—"The Use of Chills to Overcome Liquid Contraction," by R. Carrick, Shipley.

January 11, 1913.—Fifth annual dinner.

February 1.—Open discussion on Foundry Problems.

March 1.—"Constituents and Composition of Cast Iron in Relation to Fracture," by S. G. Smith, Chesterfield.

April 5.—"Moulding a Horizontal Gas Engine Cylinder," by J. G. Robinson, Halifax.

May 3.—Election of officers and discussion of Foundry Problems.

Meetings are held in the Municipal School of Technology, Manchester, at 4 p.m.

London Branch.

December 13.—Lecture by W. Rosenhain, B.A., D.Sc., National Physical Laboratory.

December 14.—Annual dinner at the Holborn Restaurant, High Holborn, W.C.

January 10, 1913.—"Mechanical Properties of Metals at High Temperatures," by F. C. A. H. Lantsberry.

February 14.—"Pattern Making," by J. W. Worrell, Luton.

March 14.—Discussion on "Foundry Failures"; open night.

April 12.—"The Application of the Microscope in the Foundry," by G. Hailstone.

Meetings are held at the Northampton Institute, St. John's Street, Clerkenwell, E.C., at 8 p.m.

Newcastle-on-Tyne Branch.

December 28.—"Every Day Difficulties in the Foundry," by E. Smith, South Shields.

January 25, 1913.—Opening meeting.

February 22.—"Commencing a Small Foundry," by E. Henderson, Heaton.

March 29.—"Cupolas, their Construction and Working," by M. E. Gallon, Dunston.

April 26.—"What a Pattern-maker sees in the Foundry," by W. Matthews, Wallsend.

May 31.—Annual meeting and dinner.

Meetings are held in the Small Hall of the Y.M.C.A. Buildings, at 7 p.m.

Scottish Branch.

December 14.—"Up-to-date Practice in Iron Founding," by G. Watt, Dumbarton.

January 18, 1913.—Problem night; open meeting.

February 15.—"Sulphur and Oxygen in Iron and Steel," by Dr. Desch, Glasgow.

March 1.—Subject to be announced later.

March 29.—Annual business meeting and discussion on Foundry Problems.

Sheffield Branch.

December 17.—"Steel Castings," by H. Brearley, Sheffield.

January 21, 1913—Annual meeting and Presidential address, by Percy Longmuir, M.Met.

February.—Date and subject to be announced later.

March.—"The Blast Furnace and its Equipment," by H. Pilkington, M.I.C.E., Chesterfield.

April.—Date and subject to be announced later.

Meetings are held in the Literary and Philosophical Society's Rooms, Church Street, Sheffield, at 7.30 p.m.

On Saturday, October 19, the marriage took place at Warrington, of Mr. H. Sherburn, second son of Mr. W. H. Sherburn, of Warrington. Mr. H. Sherburn is well known in foundry circles as the late hon. secretary of the Lancashire Branch of the British Foundrymen's Association. He has since been elected to the Council of the Branch, as a mark of appreciation of the service rendered, and the success which attended his term of office, which extended over four years.

Boron for Purifying Scrap Copper.

According to a method of purifying scrap copper or scrap copper alloys which was recently patented by W. S. Rockey and H. Eldridge, of New York, the metal is melted under a flux consisting principally of boron trioxide. The flux is first fused in a suitable furnace and the scrap metal is then charged; when the metal melts it sinks below the molten flux, which is claimed to dissolve the impurities from the molten metal with which it comes into contact. An addition of carbon is then made to the flux, which enables it to still further reduce the impurities. The nature of the impurities which the flux removes is not stated in the patent specifications, and in view of the affinity of boron for most metals with the exception of copper, it would appear doubtful whether the process could be applied satisfactorily to the copper alloys. The use of boron sub-oxide flux for pure copper, it will be remembered, was recently developed by Dr. Weintraub, of the General Electric Company, U.S.A., but that investigator makes no suggestion of the applicability of the process to alloys.

Foundry Plant and Equipment.

Crucible Melting Furnaces for High-Pressure Gas.

In many designs of furnaces considerable trouble and inconvenience have been caused by the impossibility of obtaining an even temperature throughout the furnace, whilst another serious fault is the difficulty of regulating the temperature for different classes of work. The powerful cutting action due to local heat is a further defect frequently met with.

In the furnaces illustrated, Messrs. John Wright & Company, Essex Works, Birmingham, claim to have eliminated these defects by the introduction of their single and double-jet burners, which have a large range in gas consumption, with practically no increase in the size of the burner itself. The burners are suitable for working pressures from 50 to 400 in. (water column), with ranges in consumption from 20 to 300 cubic feet per jet per hour at 100 in. (water column). In construction they are remarkably simple, and can be adjusted in a few seconds to suit working conditions .

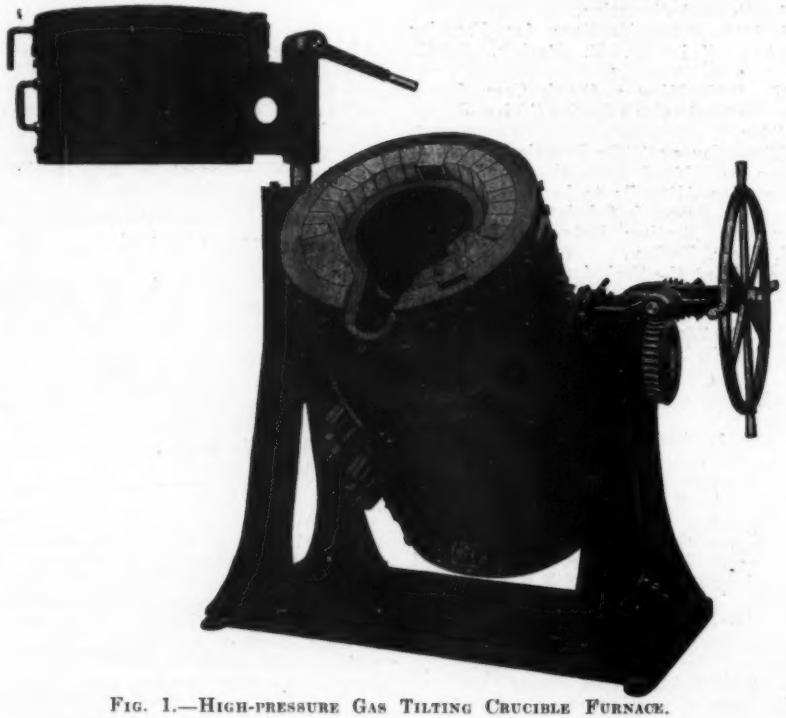


Fig. 1.—High-pressure Gas Tilting Crucible Furnace.

In Fig. 1 is shown Messrs. Wright's standard type of crucible tilting furnace (high-pressure gas), made in sizes up to 600 lbs. (brass). Near the furnace bottom is a spouted outlet for spilled metal, fitted with a wedge and plug, this, of course, also serving for clearing the furnace of metal in the event of a crucible breaking. A loose bottom plate is fitted to facilitate the renewal of the base brick. The pre-heater and top cover are of wrought steel and cast iron, lined with firebrick. A lever and cam arrangement is provided for lifting, and the whole can be swung round on a steel pillar. The lid also can be swung clear of the pre-heater to allow of the ingots being placed in the loading sleeve.

Messrs. Wright's have also a later design which constitutes an entirely new departure in crucible melting furnace construction. The furnaces are made to take crucibles of any shape and capacity from 112 to 400 lbs. (iron). They are fitted with the maker's new design of burner, and are capable of attaining a temperature of 1,700 deg. C. At the base of the central chamber, which is open at the top and provided with a detachable cover, a grid is arranged for the support of the crucible. An opening to the exterior of the furnace is formed in the furnace bottom; beneath the grid and under the outer end of this opening is hinged a counterweighted cover piece. The weight normally acts on the valve and keeps the cover in position over the opening; but in the event of a collapse or accidental breakage of the crucible, the contents flowing through the grid to the furnace bottom, where, by their weight, they depress the valve, pass away to the pan placed beneath the furnace. This arrangement eliminates the risk of choking the air and gas apertures at the lower end of the chamber, whilst serious loss of the crucible contents is also avoided. Before escaping to atmosphere the hot gases are conducted through passages formed in the walls of the crucible chamber, for the purpose of providing a hot jacket for the latter, as also a chamber for heating the ingots. This chamber, as will be seen, is furnished with a side door.

The Conoidal Fan.

A fan, which has been developed by the Buffalo Forge Company, Buffalo, N.Y., U.S.A., was recently described in "The Iron Age," from which we take the following notes. This fan belongs to the multiblade type which in recent years has proved in many ways superior to the usual centrifugal type for high-volume low-pressure service. Certain original features are claimed for which patent application has been made.

FIG. 2.—NEW DESIGN OF GAS-FIRED CRUCIBLE FURNACE.

The blade construction gives the whole wheel the shape of the frustrum of a cone, with the inlet on the side corresponding to the base of the cone. Looking straight into the inlet, the conical shape of the blades at once arrests attention. The prevalence of conical shapes in the design is responsible for the name "Conoidal," which has been given the fan. Instead of blades that have parallel edges, they are slanting, so that at the inlet side the blade is much narrower than at the back.

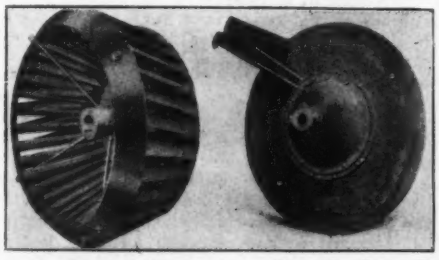


FIG. 1.—SINGLE CONOIDAL FAN WHEEL.

FIG. 2.—BACK PLATE AND HUB OF WHEEL.

To understand the advantages of this design, it is necessary to bear in mind the fact that the suction produced at the inlet of multiblade fans makes the air rush in almost at right angles against the opposite side, usually referred to as the drive side, of the fan, and its course is then abruptly broken to an angle of nearly 90 deg. toward the periphery. This abrupt deflection causes loss of power and velocity. It is this very loss that it is sought to overcome in the Conoidal fan, by the increasing width of the blade from front to back. The width of blade at the drive side is large to enable it to handle the excess amount of air. A conical, gently sloping hub also deflects the inrushing air so that it describes, it is explained, an easy unbroken curve toward the periphery. The blades are curved to a varying diameter, the curve being smallest at the inlet side and easier at the drive side, just as though curved over the surface of a cone. The grade of the curve of the blades at all points from front to back is proportioned to scoop up the air with the least impact, the diameter of the curve being in proportion to the diameter of the inlet.

Fig. 3 illustrates these various features. Compared with a centrifugal fan, the efficiency of the fan is understood to be considerably higher, and the headroom required very much smaller; it is therefore especially desirable where space is limited. The Conoidal fan also has, it is found, a practically constant efficiency curve over a total range of nearly 60 per cent., permitting a load of nearly 30 per cent.

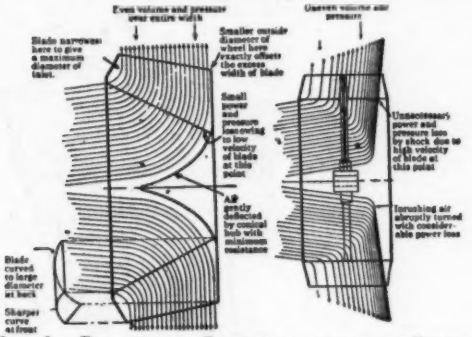

Even volume and pressure over entire width
Uneven volume and pressure
Blade narrowed here to give a maximum diameter of inlet.
Smaller outside diameter of wheel here exactly offsets the excess width of blade
Small power and pressure loss owing to low velocity of blade at this point
Air gently deflected by conical hub with minimum resistance
Unnecessary power and pressure loss by shock due to high velocity of blade at this point
Inrushing air abruptly turned with considerable power loss
Blade curved to large diameter at back
Sharper curve at front

FIG. 3.—DIAGRAM TO ILLUSTRATE HOW THE CONOIDAL FAN HANDLES AIR.

above or below rated capacity with all but maximum efficiency. The great width of each blade at the back, it is added, gives exceptional strength to the wheel, so that high speeds and loads can be maintained.

Electric Furnace for Treating Tin Dross.

In a recent issue of "Metallurgical and Chemical Engineering," Mr. R. S. Wile described an electric furnace for the treatment of tin dross and similar material. The old and still most prevalent way of smelting tin drosses is to employ the reverberatory furnace, which causes varying but large losses of tin, owing to the nature of the furnace. The average loss is in the neighbourhood of 8 per cent., and then it is necessary to add lead in order to keep the loss so low. This, of course, makes the metal unfit for tinning, and it is used for terne plating instead.

In 1908 the author tried some experiments in reducing this class of material in the electric furnace and very early hit upon a plan which has been followed since then. The dross contained from 36 to 56 per cent. tin, 9 to 15 per cent. zinc, and 10 to 18 per cent. iron, with alumina and other impurities included. The dross was a by-product of tinplate mills

and was the residue obtained after all the metallic tin, which was gathered with it in skimming the tin pots, had been melted out. Because of the zinc, lime and iron, it was extremely difficult to recover the tin in a comparatively pure state without great loss.

In the style of furnace adopted, it was decided to melt the slag first. This is not feasible in a reverberatory furnace, because it will chill when the cold dross is thrown in and it is then almost impossible to remelt it. After this slag was melted in the electric furnace, which was of the shaft type (the slag having a depth of three to four feet, depending upon the size of the furnace, and in any event taking up half the height of the furnace), the dross mixed with the proper amount of carbon and with enough silica to flux the impurities was thrown in on top and the furnace completely filled. The dross remains on top of the slag and the molten tin trickles through it and is tapped from the bottom. There is no volatilisation, as all fumes are condensed in the colder portions of the dross, the only gases escaping being those caused by the reduction, which bubble up through the dross without carrying any metallic fumes with them.

It was found that by increasing the temperature of the furnace the loss of metal was decreased. It was also found that a loss of 8 per cent. would be got by running the furnace at 3,000 to 3,600 deg. F., but by increasing this to 4,200 deg. the loss was in the neighbourhood of 0.5 per cent. As a consequence the furnace was worked at the higher temperature, using more current, of course, but obtaining more metal to offset this, and very materially reducing the loss. Slightly better results were obtained from direct-current than from alternating, not only because there were no induction losses, but because the direction of the current could be changed at will, making the top or bottom positive as desired and, consequently, hotter at the point of entry. It might be well to state that in using alternating current a power factor of at least 93 per cent. is got, because the voltage employed is rather high for furnace work, varying between 110 and 220.

The accompanying sketches show respectively the melting and the tapping positions of the electric furnace employed in the work described.

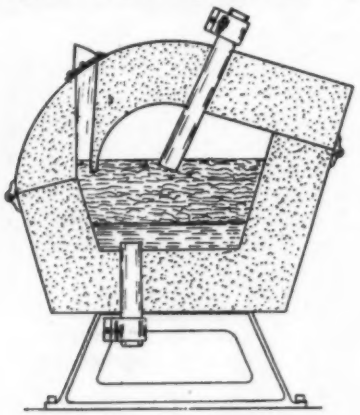


FIG. 1.—FURNACE IN MELTING POSITION.

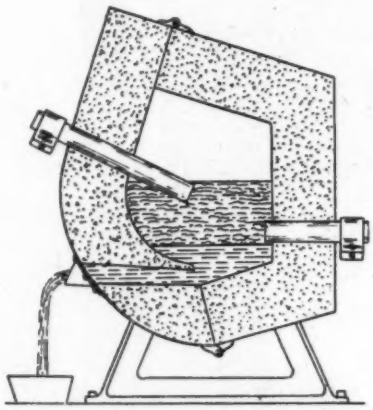


FIG. 2.—FURNACE IN POURING POSITION.

W. H. PALFREYMAN & COMPANY, 17, Goree-Piazzas, Liverpool, send a folding card relating to hydro-carbonated bone-black for case-hardening, Palfreyman's dust-preventative for bright metal surfaces, and wrought-iron case-hardening and annealing boxes.

Titanium in Malleable Castings.

In a Paper before the American Foundrymen's Association at the recent Buffalo Convention, the use of ferro-titanium with malleable cast iron was discussed by Mr. C. H. Gale, who stated that he had used a titanium alloy having 70.18 per cent. iron, 20.66 per cent. titanium, 7.46 per cent. aluminum, 0.84 per cent. carbon, and 0.83 per cent. sulphur. The usual open-hearth furnace product was used. From the same heat test bars were made of metal untreated and metal to which 0.25 per cent. alloy was added. The tensile strength of the untreated iron was 48,960 lbs. per sq. in. and that of the treated iron was 46,333 lbs.; the elongation was 6.1 per cent. in 6 in. in the first case and 5.5 per cent. in the second. In these cases the alloy was put in the 5-ton receiving ladle and then test bars were obtained with the alloy placed in hand ladles. The results obtained were as follows :—

	Tensile strength lb. per sq. in.	Elongation per cent. on 6 in.
Untreated	53,531	6.2
0.25 per cent. alloy	46,973	5.2
0.30 per cent. alloy	41,080	5.7
0.35 per cent. alloy	45,431	5.7

Mr. Gale referred to the view that the aluminum may have militated against good results and that films of aluminium oxide may have remained in the castings. He mentioned, also, the necessity of allowing the molten metal to remain at rest so that, for example, the aluminium oxide may rise and reach the slag.

For this reason it was better, as the test results showed, to apply the alloy in the large rather than in the small ladles. Another test with 0.15 per cent. of alloy containing 0.03 per cent. titanium and 0.01 aluminum showed 50,580 lbs. tensile strength and 5.2 per cent. elongation with the untreated specimen and 49,417 lbs. tensile strength and 5.4 per cent. elongation with the alloy. With 0.20 per cent. of the alloy, the tensile strength of the untreated iron was 51,070 lbs. and of the treated iron 54,637 lbs., and the elongation was 5.5 and 7.1 per cent. respectively. With transverse tests of ½ by 1-in. bars on supports 12 in. apart, the average load for the first series was 1,285 lbs. for the untreated iron and 1,328 lbs. for the treated, and for the second series, the load was 1,230 lbs. for untreated iron and 1,385 lbs. for treated iron.

Inventions.

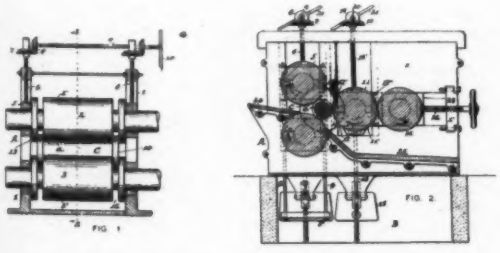
Applications for Patents.

An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

24,495. Casting process and apparatus. F. G. S. Price.
24,626. Crucibles for electric furnaces. Morgan Crucible Company, Limited, and C. W. Speirs.
24,709. Method of chilling cast-iron rolls. G. H. Onions.
25,597. Casting either iron or steel projectiles for use with ordnance with a metal collapsible core. T. J. Simons.
25,598. Non-ferrous metal ingot casting stand combined with apparatus for drawing off smoke, fumes, etc., from ingots during pouring. W. Thomas.
26,082. Electric furnaces and process of operating same. (General Electric Company, United States.)
26,165.*Electric electrode furnaces. Jossingfjord Manufacturing Company A/s.
26,166.*Tilting arrangement for metallurgical furnaces. Jossingfjord Manufacturing Company A/s.
26,203. Process of converting iron into steel. F. F. Palli.
26,930. Casting metals. T. Thorp.
26,980. Manufacture of steel. E. H. H. Gordon and R. J. W. Brown.

Abstracts of British Patent Specifications recently accepted.

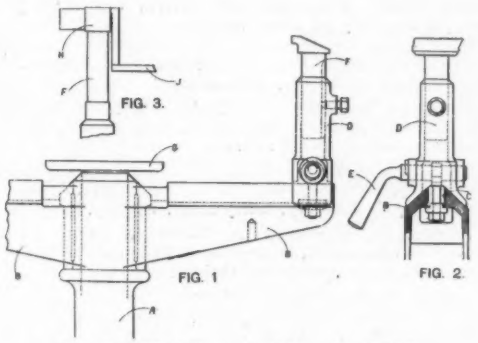
5,519 (1912). *Method of Treating Cast Metal Ingots.* J. C. Russell, Magee Building, Pittsburg, Pennsylvania, U.S.A.—Fig. 1 is a vertical section of the apparatus showing the rolls in full lines; Fig. 2 is a vertical central section of the same on the line 2, 2, Fig. 1, and looking in the direction of the arrow. The ingot, such as is shown at *a* in Fig. 1, is formed round or circular in cross section and of conical shape, by its outer face being tapered throughout its length. The ingot *a*, after it is taken from its mould in a semi-plastic condition, is placed on the inclined table 24 in front of the rolls 2 and 3, which will allow such ingot to roll down the table and through the opening between the rolls and against the rolls 3 and 11, so that when the upper roll 2 is lowered against the ingot by shaft 9, pinions 7 and 8, and rods 6 bearing against the blocks 5 for such roll, the ingot will be confined within the working space C between



Method of Treating Cast-Metal Ingots.

the rolls 2, 3 and 11. As the rolls 2, 3 and 11 are power-driven in the usual manner, and revolving in the direction indicated by the arrows, it will be evident that the ingot *a* will be revolved or spun around within the space C between such rolls, so that by reason of the rolls acting on the enlarged end of the ingot through the continued adjustment of the roll 2 against the same, such ingot will assume a complete circular form and of the same size throughout its length, while the molten metal within the same and segregations therein will be caused to be projected from such enlarged end towards the other end of the same, and thus forcing out the gases in the ingot at its smaller end and sides, and any segregations at the enlarged end will be removed under the pressure of the rolls, forming a solid ingot throughout when rolled down to such circular shape. As the ingot *a* is thus formed to circular shape throughout its length by its revolving operation in the space C between the rolls 2, 3 and 11, the end rollers or disks 14 in the space and held by the rolls will act to hold the ingot within the space and engage the ends of the ingot to keep the same flat and in proper finished shape, as well as prevent the metal from running out of the ends in the flattening of the ingots. After the ingot *a* has thus been rolled down to its desired circular shape, the roll 21 is drawn back from the roll 11, and the roll 11 is raised so that the ingot can drop and roll down the inclined table 25 under the rolls to the rear of the rolling mill.

27,724 (1911). *Foundry Moulding Machines.* A. P. Smith, trading as the Britannia Foundry Company, Cox Street, Coventry.—Figure 1 is a partial front elevation, and Figure 2 an end view partly in section, of a moulding machine constructed in accordance with this invention; Figure 3 is a partial side view of a modification. The pedestal A of the machine is formed with two oppositely projecting arms B, and each of these is slotted lengthwise at C. The upper surface of each arm is bevelled as shown, and upon this part the bracket D is adapted to slide, its under surface



Foundry Moulding Machine, by Smith.

being shaped to correspond with the upper bevelled surface of the arm. The upper surface need not, however, be bevelled, or it may have more than one bevel. Each bracket is provided with a simple clamping device actuated by the lever E, whereby it can be locked in any desired position on the arm. The upper end F of each bracket may be detachable from the main portion D, and adjustable in relation thereto to provide some adjustment in height. It will be understood that the arms B are rigid, which is not the case with most moulding machines of this type. Furthermore, in the present instance the table or the equivalent upon which the pattern rests is arranged centrally on the rising and falling plate G and affords a central support during ramming. The adjustable brackets may also, as shown in Figure 3, be fitted with trunnions H, and may be used in connection with a turnover table J, in which case the pattern plate table would be used to lower the moulding box after the upper table is revolved.

2,021 (1912). *Process for Manufacturing Compound Steel Plates, Armour Plates, etc.* H. Braun, 5, Mühlenstrasse, Schöneberg-Berlin, Germany.—The casting process is carried out in such a manner that the mould is divided by means of two slides into three corresponding compartments, the middle compartment being filled at the same time with a compensating metal. During the casting operation the slides are pulled upwards in the usual manner at a suitable moment, in order to produce the union of the three layers.

Trade Talk.

WILSON & LONGBOTTOM, LIMITED, engineers, of Nelson Street, Barnsley, Yorks., are extending their premises.

THE NEW GARTER FOUNDRY COMPANY, LIMITED, are removing to the Groveland Foundry, Dudley Port, Staffs.

THE VULCAN STEEL AND TOOL COMPANY have established themselves in business at 22, High Street, Sheffield.

THE CANNLEY FOUNDRY COMPANY, LIMITED, iron and brass founders, are erecting works in Beach's Field, Chelmsford.

THE GOTHIC FOUNDRY, Falkirk, of R. & A. Main, Limited, was the scene of a fire recently, but the damage was only slight.

S. A. DANIELL, LIMITED, engineers, etc., of the Lion Works, Birmingham, have established a branch at 12, Lever Street, Manchester.

AN iron foundry is shortly to be started at Dalry, Ayrshire. A suitable site has been secured, and other arrangements are well forward.

A FIRE occurred recently at the works of Perrin, Hughes & Company, Limited, brassfounders, Liverpool, but the damage was not heavy.

FRANK WIGGLESWORTH & COMPANY, LIMITED, of the Clutch Works, Moss Street, Bradford, are erecting a new pattern shop at their works.

E. F. BLAKELEY & COMPANY (LIVERPOOL), LIMITED, constructional engineers, of Liverpool, have removed to the Vauxhall Ironworks, Birkenhead.

POLLOCK & MACNAB, LIMITED, of the Britannia Machine Tool Works, Bredbury, Manchester, propose carrying out extensive improvements at their works.

THE YORKSHIRE RANGE AND MANTEL COMPANY, LIMITED, propose carrying out extensive alterations to their Prospect Foundry, Otley Road, Shipley.

MESSRS. A. ROBINSON & COMPANY, Victoria Iron Works, Brighouse, have appointed Mr. C. A. Taylor, Crown Street, Brighouse, as their sales agent.

MESSRS. A. SHAW and J. MURCHIE, carrying on business as engineers at Chesterfield Street, Nottingham, under the style of Shaw & Murchie, have dissolved partnership.

THE ASTER ENGINEERING COMPANY, LIMITED, of Wembley, Middlesex, have started the manufacture of the Aster semi-Diesel engine under the Westinghouse-Cross patents.

A NEW foundry is shortly to be added to the works in Church Street, Pillgwenlly, Newport, Mon., of the Newport Brass Foundry and Coppersmiths' Company, Limited.

BY an outbreak of fire which occurred on November 12 slight damage was done to the premises of Messrs. Brown & Company, ironfounders, 70, Mountblue Street, Glasgow.

MESSRS. W. E. MOULSDALE & COMPANY, metal merchants and engineers, Hamilton Buildings, 24, Chapel Street, Liverpool, have removed to 6, Castle Street, Liverpool.

THE works of Messrs. J. Dudley & Sons, shovel manufacturers, etc., of Norbriggs, near Staveley, which have been closed down for several years, are to be re-opened again shortly.

A FIRE occurred recently at the tube works of Messrs. Cranmore & Company, Aston Brook Street, Birmingham. The damage done, principally to the bending shop, was somewhat heavy.

"THE VOLATILITY OF METALS" was the subject of Professor Thomas Turner's presidential address to the members of the Metallurgical Society of the Birmingham University recently.

DOBBIE, MCINNES, LIMITED, engineering instrument makers, 57, Bothwell Street, Glasgow, have removed their London office from 113, Fenchurch Street, E.C., to 9, Billiter Square, E.C.

MESSRS. W. A. DAVIS & COMPANY, 13, Kinghorn Street, London, E.C., have been appointed British agents of Mr. A. Kussmann, Coln-Rhein, Germany, manufacturer of cast and engraved metal name-plates.

AN outbreak of fire occurred recently at the Delta Metal Works, Birmingham, of the Delta Metal Company, Limited. The roof of the engine-house was involved, but the flames were speedily subdued.

THE partnership heretofore subsisting between Messrs. G. B. Holmes and A. D. Allen, lately carrying on business as engineers, at Wellington, New Zealand, under the style of Holmes & Allen, has been dissolved.

THE METALLURGICAL ENGINEERING COMPANY, LIMITED, is being wound up voluntarily, with Mr. P. E. Mann, 4, Broad Street Place, London, E.C., as liquidator. A meeting of the creditors will be held on November 5.

MR. A. BROOK has acquired the business of Messrs. H. Jaggar & Company, engineers, of the Garage, Batley, and Halifax Road, Dewsbury, and will carry it on in Hanover Street, Batley, as A. Brook & Company.

THE members of the Sheffield Society of Engineers and Metallurgists recently attended an interesting lecture on "Blowholes in Steel," by Dr. J. E. Stead, F.R.S., at the Old Firth College, Mr. W. F. Beardshaw presiding.

THE business of Messrs. Charles Neat & Company, 112, Qreen Victoria Street, E.C., has been transferred to the premises of Messrs. C. W. Burton, Griffiths & Company, 1-3, Ludgate Square, Ludgate Hill, London, E.C.

THE partnership heretofore subsisting between Messrs. S. C. Bruton and J. Lloyd, carrying on business as engineers at 105, Vyse Street, and Constitution Hill, Birmingham, under the style of Bruton & Lloyd, has been dissolved.

THE creditors of the Dudley Tool and Ironworks Company, Limited, which is being voluntarily wound up, are required to send particulars of their claims to Mr. W. G. Podbury, 83, Colmore Row, Birmingham, the liquidator, by December 28.

A MEETING of the Klein Engineering Company, Limited, will be held at Spring Gardens, Manchester, on Monday, December 30, to receive the report of the liquidator, showing how the winding-up of the Company has been conducted and its property disposed of.

MESSRS. A. STAGG & F. STAGG, steel and file manufacturers, trading as A. & F. Stagg, Artizan Works, Sheffield, are paying a supplemental dividend of 10s. 6d. in the £. In the separate estate of Mr. F. Stagg a first and final dividend of 20s. in the £ is being paid.

THE HARDENITE STEEL COMPANY, LIMITED, of the Royds Works, Attercliffe Road, Sheffield, have taken over the export business of Thos. Andrews & Company, Limited, Wortley Steel Works, and Royds Works, Attercliffe Road, Sheffield. The two companies are associated concerns.

C. E. RICHARDSON & COMPANY, LIMITED, engineers, of the Finbat Works, Napier Street, Sheffield, have been fined 30s., including costs, for having neglected to report an accident to the Factory Inspector within a specified time, according to the provisions of the Notices of Accidents Act.

THE business of the late Mr. C. D. Phillips, J.P., the proprietor of the Emlyn and Central Iron Works, Newport, Mon., will be continued as hitherto under the joint management of Mr. C. G. Phillips, eldest son, and Mr. T. M. Prosser, who has been associated with the business for some 30 years.

MR. JAMES S. ELLIS, of Birmingham, has resigned his position as Midland representative of the Lanarkshire Steel Company, Limited, to take up a similar position under Messrs. F. W. Jackson & Company, agents for the Consett Iron Company, Limited, and will enter into his new duties on December 2.

VEITHARDT & COMPANY, LIMITED, engineers and merchants, of 26 and 27, Bush Lane, Cannon Street, London, E.C., have added to their business a department for the supply of locomotives, wagons, wheels, axles and tyres, rails and all accessories, sleepers (steel and wooden), and railway material of every description.

WM. ATKINS & COMPANY, LIMITED, of the Reliance Steel Works, Sheffield, have issued particulars of a recent test made by the Sheffield Testing Works, Limited, of their "Waco" high speed steel. The tool removed in 10 minutes 20.23 lbs. of material from a hard steel bar, containing 0.89 carbon and 0.75 manganese.

A FIRE, causing considerable damage, occurred recently at the works of John Buckley (Dudley), Limited, malleable ironfounders, Royal Works, Church Street Dudley. The outbreak originated in the polishing shop on the upper storey, and in spite of the efforts of the fire brigade the building was practically gutted.

A SPECIAL meeting of the Birmingham Metallurgical Society was held on November 12 in the Metallurgy Lecture Theatre of the Birmingham Municipal Technical School, when a paper on "Some Notes on High-Speed Steels" was read by Mr. Walter Carter, of Sheffield. The chair was taken by Mr. J. H. Stansbie, B.Sc., F.I.C.

MR. W. SPENCE HASWELL announces that Tangyes, Limited, having ceased to maintain their Newcastle branch house, of which he has been manager for the past twelve years, he has started business on his own account at Manchester Buildings, Dean Street, Newcastle. He represents several well-known engineering firms producing specialities.

THE partnership which has for some time past been carried on by E. Hall, of Fosse House, Wolverhampton Road, Walsall, and T. Hill, of 80, Wolverhampton Street, Walsall, under the style of T. Hill & E. Hall, at The Walsall Engineering Works, Wolverhampton Road, Walsall, has been dissolved. The business will in future be carried on by Mr. E. Hall.

MR. C. A. HUNTON, steel merchant, of 110, Bishopsgate, London, E.C., will in future carry on business as C. A. Hunton & Sons, engineers and merchants, Gloucester House, 110, Bishopsgate, E.C. The firm's specialities are punching and shearing machines, and they are also London agents for Moses Eadon & Sons, Limited, of the President Steel Works, Sheffield.

MURPHY, STEDMAN & COMPANY, LIMITED, Gamage Buildings, Holborn, E.C., have been appointed sole London and Southern agents for the Britannia Foundry Company's "Coventry" moulding machine, and also for the same company's sand mixing machine (Alfred Herbert's Patent). They have opened a show-room at 180, Grays Inn Road, W.C., where these machines are on exhibition.

IN connection with Meldrum Brothers, Limited (in liquidation), we are informed that the works and assets at Timperley, together with the goodwill and book debts outstanding, have been transferred to a new company, formed for the purpose, which will continue the business under the style of Meldrums, Limited, of which company Mr. John W. Meldrum, who has been manager during the liquidation, will be the managing director.

JOHN BROWN & COMPANY, LIMITED, of Sheffield, have issued a circular to their shareholders offering the balance (£150,000) of the unissued £10 5 per cent. cumulative preference shares at par. The reason given for the offer of these shares is the demand of the expanding business of the company for more working capital. The share capital of the company is £4,000,000, consisting of £2,250,000 ordinary shares and £1,750,000 preference shares, including the present proposed issue of £150,000.

APPLICATION having been made to the Insurance Commissioners for the determination under Section 66 of the National Insurance Act of the question whether agents paid by commission or fees who are employed for part-time or spare-time service only to canvass for business or to collect monies, are employed under a contract of service within the meaning of the National Insurance Act, the Commissioners give notice that a hearing of parties interested will take place on Monday, December 9, at 2.30 p.m., at Wellington House, Buckingham Gate, London, S.W.

ELECTRO-METALS, LIMITED, of 9½, Union Court, Old Broad Street, London, E.C., are supplying to the order of Kayser, Ellison & Company, Limited, Sheffield, one of their two-phase steel-refining furnaces. This type of furnace employs two-phase current and can, therefore, be supplied by means of stationary transformers from any two or three-phase electric supply system. The current from the two top electrodes passes through the bath to the third, neutral, bottom electrode. By this arrangement a vertical circulation is set up within the bath, which brings all of the charge successively into intimate contact with the slag and thus facilitates the refining. Electro-Metals, Limited, have for some time past had an experimental furnace of this type working in a Sheffield steel works, and have there developed it to its present state of excellence. Another similar furnace is also working at a Swedish steel works. In addition to these steel-refining furnaces Electro-Metals, Limited, also hold the British, American and Mexican rights for the electric pig-iron smelting furnaces which have recently been successfully developed in Sweden. Already there are in that country and in Norway furnaces built or building for an output of about 150,000 tons annually of electric pig-iron, and we understand that negotiations are in progress for further installations of these furnaces.

Legal.

Reliability of Sheffield Castings.

At the Sheffield County Court, recently, the action was continued in which Cammell, Laird & Company, Limited, claimed £76 from Messrs. Owen, Isaacc & Owen, of Portmadoc, Carnarvon, the price of two gear wheels. A fortnight ago it was contended by Mr. A. Neal, for the defendants, that the steel used in the manufacture of the gear wheels did not contain the carbon specified; which were in consequence so soft that they wore out in a few weeks. The analysis showed 0.24 per cent. of carbon.

Mr. John Watson, manager of Messrs. Cammell's steel foundry, whose cross-examination by Mr. Neal was resumed, admitted that a mistake had been made in regard to the specification of the second wheel supplied (to replace the first wheel)—the specification, 0.22 to 0.26 carbon, not being the right one for the work.

Maurice Jones, who said he had been the driver at the main incline at the quarry for 20 years without accident, said the gear wheels had had proper treatment and denied the plaintiffs' suggestions that they had been subjected to improper braking. The wheels began to burr after the first day's work.

Mr. George Fielding, assistant foundry manager at Messrs. Cammell's, spoke to a visit he paid to the quarry where the gear wheels were working without lubrication, and showing signs of wear that confirmed the impression he formed that the undue wear was attributable to the lack of lubrication, and the way in which the powerful brake was applied—bringing the whole train of gearing violently to a standstill.

Several other witnesses were called to support the plaintiffs' contention that the undue wear of the wheels was due to improper braking. Mr. William Cleland, of the Sheffield Testing Works, said his test showed that the material was quite up to the usual specification for gearing purposes, but in cross-examination by Mr. Neal he admitted that the signs of wear might point either to such improper usage or to excessive softness of the material.

Dr. Arnold, of the Metallurgical Department of Sheffield University, said from his examination of the section of the gear wheel he formed the conclusion that it had not been lubricated, had not been mounted true, and periodically subjected to shock such as would be occasioned by the sudden application of a powerful brake. He could form no opinion as to the life of a gear subjected to such abnormal conditions—especially the lack of lubrication.

In cross-examination by Mr. Neal: For gears his preference was for steel containing between 0.3 and 0.4 carbon, and he would consider material with only 0.24 as too soft for the purpose.

In delivering judgment, His Honour Judge Benson said that the contract was for plaintiffs to make

and supply cast-steel pinion and spur for steel gearing capable of transmitting from a motor 150 b.h.p. at 550 revolutions per minute for £118, with no warranty. The obligation on plaintiffs was to make and supply this gearing of cast-steel suitable to the known purpose for which it was to be employed, and he thought this primary obligation was in no way lessened by the fact that no warranty was to be implied. The defendants said the gearing supplied by the plaintiffs was not suitable. The wheels were applied to an electric motor at a quarry on January 30, 1911, but by April 18 had shown such signs of wear in the teeth that they were stopped and not again worked. Defendants ordered a pair of replace wheels, and complained of the bad wear of the first wheels.

Plaintiffs said it must be due to overloading, and had them returned for examination. The replace wheels, however, went the same way. Mr. Fielding, plaintiffs' assistant foundry manager, visited the quarry and pointed out the absence of lubrication, and that the brake was put on too suddenly. Afterwards, wheels obtained from Messrs. Angus & Company, but made in fact by plaintiffs, were put on and worked satisfactorily.

In the circumstances he thought the defendants had failed to show by analysis and test that the wheels were made of unsuitable material, and that the cause of their undoubted breakdown must be looked for elsewhere. He thought that was to be found in the evidence of Mr. Fielding as to the treatment of the wheels. The first wheels were not properly fitted to each other by the defendants, the driver was inexperienced, and after winding the trucks up 70 yards of incline he only had three or four yards on the level in which to cut off the current and apply the brake to stop them. The damage went on till Mr. Fielding's visit on September 1, and after his observations when the Angus wheels were put on—made of practically the same metal as the replace wheels—they worked quite satisfactorily.

His Honour had come to the conclusion that the failure of the first wheels and replace wheels was due to their being subjected to abnormal usage at the quarry, and not to their being constructed of unsuitable material. He gave judgment for the plaintiffs for £76, to include the sum paid into Court.

Economy and Improvements in Brass Foundry Work.

In a Paper on this subject, presented before the German Foundrymen's Association, Herr C. Hunger discussed the possibility of reducing prime costs—materials, wages and general expenses—in brass foundry work. In the cost of materials, economy can be effected by selecting the most suitable cheap alloy for a given purpose; and the alloys can be cheapened by using old metal, turnings and other waste. The briquetting of scrap is advisable where the scrap is produced on the premises, or can be bought with a guarantee of composition; otherwise there is a great risk of undesirable nickel and aluminium being introduced into the alloys. In addition to diminished waste and coke consumption, and improvement in quality in consequence of the better prevention of oxidation, briquetting affords the great advantage that the analysis of a trial melt of, say, 2 cwts. of briquettes enables one to guarantee equal composition in a 10-ton lot, and by the use of such uniform additions, a constant quality of final product can be obtained, and as briquettes are cheaper than new metal of the same composition, a considerable saving results. Care in the melting process also leads to economies, loss in tilting being avoided by not filling the crucibles too full. To prevent waste in trimming and fettling, the author recommends the use of band saws. In new working methods, oil fuel is recommended, the best furnace being the one in which efficient atomisation of the fuel is effected at the lowest pressure. With this fuel the working costs are lower than with gas, and the work is much simpler, cleaner and more reliable.

Deaths.

Mr. E. Boyd, of Messrs. Edward Boyd & Sons, Hope Iron Works, Holderness Road, Hull, died recently at the age of 67.

Mr. W. Ballantyne, a director of the Airdrie Iron Company, Limited, died at Coatbridge on November 19, after a short illness.

Mr. W. H. Hacking, of Hacking & Company, Limited, Californian Works, Lord Street, Bury, died recently aged 75 years.

Mr. Peter Bell, partner of the firm of Peter Bell & Sons, Pitt Street Ironworks, Edinburgh, died recently. He was 62 years of age.

Mr. E. Bibb, founder of the firm of Messrs. E. Bibb & Sons, brassfounders, Windmill Street, Birmingham, died recently, aged 74 years.

The death is announced of Mr. C. Green, the manager of the Phœnix Special Steel Works, Ickles, Rotherham, of Steel, Peech & Tozer, Limited, aged 51 years.

Mr. C. G. Jordan, of Newcastle-on-Tyne, who at one time was the proprietor of an ironfounding business at Newport, Mon., died recently. He was 52 years of age.

Mr. R. M. Lord, a director of Richard M. Lord, Limited, safe manufacturers, Victoria Works, 32, Cleveland Street, Wolverhampton, died recently at the age of 75 years.

Mr. William Ainslie, of Kents Bank, Grange-over-Sands, who for many years held a responsible position in Monkbridge Iron and Steel Works, retiring about twelve years ago, died recently.

Mr. W. C. Barker, aluminium and brass founder, of Gun Lane, Strood, Rochester, died recently, at the age of 68. He retired from business some twelve months ago, which has since been carried on by his son.

Mr. J. M. B. Mowle, who established in 1849 the Egerton Street Ironworks, Chester, under the style of Williams & Mowle, died recently. The deceased gentleman retired from the business about 20 years ago.

Mr. W. H. Rankine, J.P., of Falkirk, died on November 23. Mr. Rankine, who was over seventy years of age, was an engineer by profession, and he spent a considerable period abroad in connection with engineering work.

Mr. J. Ryder, of Messrs. Ryder Brothers, ironfounders, 119, Bark Street, Bolton, died recently at Blackpool, aged 79 years. The business was established by the late Mr. Wm. Ryder, uncle of the deceased, who has been associated with it for over 40 years.

The death has occurred, in Glasgow, of Mr. J. W. Shepherd, a well-known figure in shipbuilding and engineering circles. Up till a few months ago Mr. Shepherd was actively engaged in controlling the affairs of the London and Glasgow Engineering and Iron Shipbuilding Company, Limited, of which he was managing director.

Mr. Ernest Gilbey Allison, a joint manager of the Seaham Harbour Engine Works, died recently, aged 55 years. Mr. Allison, who succumbed to an attack of diphtheria, had only been ill a week. He went to the Seaham Engine Works as chief draughtsman about ten years ago, and after the departure of Mr. Donovan, became joint manager with Mr. J. Harrison.

The death has occurred, at Bedford, of Mr. Henry Carrick, of Redheugh. Mr. Carrick was a native of Haltwhistle, and served his apprenticeship with Robert Stephenson & Company, Limited, engineers, Forth Banks, Newcastle, and afterwards became associated with railway work in India. Returning home, he established the works of Carrick & Wardale, Redheugh Engine Works, Gateshead-on-Tyne.

Mr. T. W. Robinson, who established the business of Thomas W. Robinson, Limited, Dennis Park Ironworks, Stourbridge, Worcester, died recently at Kingswinford, near Dudley, at the age of 68 years. It was over 50 years ago that the works were established, and the deceased gentleman was connected with them up to the time of his retirement in 1907, when they were taken over by the present proprietors.

Mr. R. A. Douglas, proprietor of the firm of James Gray & Son, kitchen range and safe makers, 89, George Street, Edinburgh, died recently from heart failure. The deceased, who was 64 years of age, had been connected

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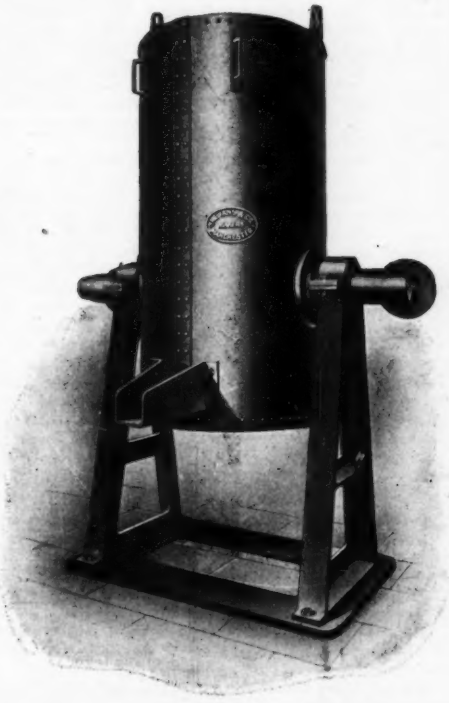

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Telegrams: "LADLES, MANCHESTER."

with the iron trade all his life. He began business on his own account in Edinburgh in 1878, and five years later took up a position with James Gray & Son, eventually becoming sole partner.

THE death occurred recently, at Babbacombe, South Devon, of Mr. T. B. Brittain, a member of a well-known Sheffield family. Mr. Brittain, who was in his 79th year, was the eldest brother of Mr. W. H. Brittain and Mr. Frederick Brittain, of Sheffield, and was formerly a partner with the former in the firm of William Hall, steel and file manufacturers, of the Alma Works. In 1855 he retired from business.

THE death occurred on November 12 of Mr. T. H. Bainbridge, of Newcastle-on-Tyne and Leeds. Mr. Bainbridge was 70 years of age, having been born in Newcastle in 1842. His father sprang from an old Weardale family settled in the neighbourhood of Eastgate for several centuries. He and was vice-chairman of the Consett Iron Company, was interested in many commercial concerns on Tyneside, Limited, a director of the Consett Spanish Ore Company, Limited, of Swan, Hunter and Wigham Richardson, Limited, and of the Wallsend Slipway and Engineering Company, Limited. Apart from his business, Mr. Bainbridge, although well known in Newcastle, and a magistrate for the last twenty years, took little part in public affairs.

MR. DUNCAN SINCLAIR, J.P., of Roseneath, Wellington, managing director of the Sinclair Iron Company, Limited, of Ketley, Wellington, Salop, died recently. The deceased, who was 55 years of age, was born in Argyllshire. He first became associated with the iron industry at the Carron Company's works at Carron, and later he went to London to represent the heavy foundry department for the company. Fifteen years ago Mr. Sinclair was appointed manager of the Coalbrookdale works. He travelled a great deal in Europe, America, and Canada, chiefly in order to secure information as to the educational systems in operation in those countries. Eighteen years ago the deceased started the Sinclair Iron Works, at Ketley, the chief business being the manufacture of light castings, and there are now over 200 hands employed there.

MR. MAUNSEL WHITE, the well-known American metallurgist, died on October 22, at the age of 56. Following his University career and technical training, the deceased gentleman was engaged by the Bethlehem Steel Company, and in a short time became chief of the metallurgical department of that corporation, taking very high rank as an authority upon metals. Mr. White, as representative of the Bethlehem Company, made frequent visits to Europe, and arranged armour-plate contracts with the Government of Russia. The world at large will best remember him from the part which he took in the investigation that led up to the discovery and development of high-speed tools. In co-operation with Mr. F. W. Taylor, he invented the Taylor-White process of hardening tool steel. He was a member of the British Iron and Steel Institute.

Personal.

MR. J. G. STEWART, of Stewarts & Lloyds, Limited, has been elected Provost of Dunblane.

THE late Mr. John Eddy, of the Kennford Iron Works, Kennford, near Exeter, left estate valued at £2,524 gross.

MR. C. S. BALL has been elected a director of Brown & Green, Limited, ironfounders and engineers, of Windsor Street, Luton, Beds.

MR. ALFRED HERBERT, of Alfred Herbert, Limited, has been elected chairman of the Machine Tool and Engineering Association, Limited.

MR. CHARLES W. TAYLOR, of the Borough and North-Eastern Foundries, South Shields, has been added to the Commission of the Peace.

MR. A. M. SUNDERLAND, of G. B. Sunderland & Company, Limited, has been elected a director of Mordey, Carney & Company, Limited.

THE late Mr. J. Proctor, J.P., of Jonas Proctor & Sons, Limited, engineers, Moses Gate, near Bolton, left estate valued at £42,270 gross.

THE late Mr. E. D. Prideaux, of Messrs. E. D. Prideaux & Company, brassfounders, Birmingham, left estate of the gross value of £3,042.

PROFESSOR DUNKERLEY, Professor of Engineering at Manchester University, who died on September 4 last, left estate of the gross value of £1,525.

THE late Mr. R. D. Vernon, chairman of D. Vernon & Company, Limited, engineers, left estate of the gross value of £17,443, of which £10,516 is net personalty.

THE late Mr. G. Ingham, of Messrs. John Ingham & Sons, engineers, of the Victoria Works, Middlestown, near Wakefield, left estate of the gross value of £2,206.

SIR HUGH BELL, BART., who has been a member of the Tees Conservancy Commission for 37 years, has been re-elected chairman of that authority for the ensuing year.

THE late Mr. G. B. Wood, late general works manager of Cammell, Laird & Company, Limited, of Sheffield, left estate of the gross value of £4,705, of which £4,419 is net personalty.

THE late Mr. J. E. Hodgkin, managing director of the Pulsometer Engineering Company, Limited, left estate of the gross value of £30,115, of which £26,373 is net personalty.

MR. STEPHEN W. FURNESS, M.P., has been elected chairman of the South Durham Steel and Iron Company, Limited, in place of the late Lord Furness, who had been chairman since March, 1900.

MR. A. G. WARREN, B.Sc., who two or three years ago was a lecturer on engineering in the East London College, has been appointed lecturer in the Engineering Faculty of Hong Kong University.

MR. L. C. PARKES, managing director of Thos. Black & Sons, Limited, edge tool makers, Sea View Works, Berwick-on-Tweed, has been elected to fill a vacancy in the representation of the Spittal Ward in Berwick Town Council.

MR. J. S. KERR, manager of the steel melting department at the works of Palmers Shipbuilding and Iron Company, Limited, has been appointed to take charge of the open-hearth plant of Bolckow, Vaughan & Company, Limited.

MR. WM. RAWLINSON, foundry manager at Messrs. E. Bennis & Company's engineering works at Little Hulton, near Bolton, has been the recipient of a presentation from the workmen on the occasion of his leaving to take up a similar appointment with a Manchester firm.

MR. JAMES WALKER, Assoc. M.Inst.C.E., M.I.Mech.E., is about to join the staff of Boving & Company, Limited, water power engineers, of 94, Union Court, E.C., and will also join the board of directors. Mr. Reginald K. Morcom has also consented to act on the board of Messrs. Boving & Company.

THE secretary of the recently-formed British Engineers' Association informs us that the following officers have been elected:—President: Mr. Douglas Vickers. Vice-Presidents: Sir Robert Hadfield, F.R.S.; Mr. Herbert Marshall; Sir William Mather, P.C., LL.D.; Mr. C. C. Scott; Sir John I. Thornycroft, LL.D., F.R.S. Chairman of Executive Committee: Mr. Wilfrid Stokes (Ransomes & Rapier, Limited). Members of Council, those being marked with an asterisk being members of the Executive Committee: Messrs. *H. Allcock (W. T. Glover & Company, Limited), A. Anderson (Edward Wood & Company, Limited), *T. O. Callender (Callender's Cable and Construction Company, Limited), W. Collingwood (The Vulcan Foundry, Limited), *Percy B. Crowe (W. H. Allen, Son & Company, Limited), F. R. Davenport (Willans & Robinson, Limited), *W. H. Dixon (Hadfield's Steel Foundry Company, Limited), *J. Cunningham Ford (T. Cooke & Sons, Limited), G. B. Hunter (Swan, Hunter & Wigham Richardson, Limited), Stainer Hutchins (The Power-Gas Corporation, Limited), Edward Jackson (Midland Railway Carriage and Wagon Company, Limited), Christopher James (Joshua Buckton & Company, Limited), H. Norman Leask (Heenan & Froude, Limited), *R. S. Lloyd (Hayward-Tyler & Company, Limited), Howard Marsh (George Fletcher & Company, Limited), Charles S. Schultz (Dick, Kerr & Company, Limited), *Arthur H. Smith (Holman Brothers, Limited), T. Cuthbert Stewart (Stewarts & Lloyds, Limited), Philip Thaine (Vickers, Limited), John E. Thornycroft (John I. Thornycroft & Company, Limited), *Thomas Woof (Alfred Herbert, Limited).

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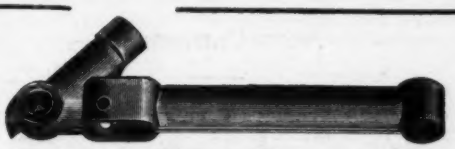

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From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Collieries, Ltd., Cardiff.

New Companies.

Oil-Flame Furnace Company, Limited.—Capital £80,000 in £1 shares.

James Livingston, Limited.—Capital £2,000 in £1 shares, to carry on the business of engineers.

Base Metal Syndicate, Limited.—Capital £6,000 in £1 shares. Registered office, 80, Bishopgate, E.C.

Hayhurst & Higginson, Limited.—Capital £3,000 in £1 shares, to carry on the business of engineers.

L. W. Tools Company, Limited.—Capital £5,000 in £1 shares, to carry on the business of tool makers, etc.

Herculum Metal Company, Limited.—Capital £3,000 in £1 shares. Registered office: 8, Great Bath Street, London, E.C.

Stereophagus Pump and Engineering Company, Limited.—Capital £2,000 in £1 shares. Registered office: 39, Victoria Street, S.W.

Kena, Limited.—Capital £20,000 in £1 shares, to carry on the business of mechanical engineers, etc. Registered office: Keynsham, Somerset.

Stag Company, Limited.—Capital £3,000 in £1 shares, to carry on the business of engineers. Registered office: 538a, Mansfield Road, Sherwood, Nottingham.

W. M. Richmond & Company, Limited.—Capital £20,000 in £1 shares, to carry on the business of engineers, etc. Registered office: 55, Broad Street Avenue, E.C.

T. E. Salter, Limited.—Capital £2,000 in £1 shares, to carry on the business of engineers, etc. Registered office: 104 & 105, Bloomfield Street, Prince's End, Tipton.

White Brothers & Shaw, Limited.—Capital £1,000 in £1 shares (800 preference), to carry on the business of engineers, etc. Registered office: 16, Lower Hamlets Road, Dover.

Harry H. Garday & Company, Limited.—Capital £15,000 in £1 shares, to carry on the business of engineers, etc. Registered office: The Wharf, Church Street, Staines.

Moffat, Ross & Company, Limited.—Capital £10,000 in £1 shares (5,000 5 per cent. pref.), to carry on the business of lighting engineers. Registered office: 209, Upper Thames Street, E.C.

Duckett, Morrison & Company, Limited.—Capital £5,000 in £1 shares, to carry on the business of engineers. Registered office: Platt Bridge Works, Bayley Street, Stalybridge, Cheshire.

Metallurgical and General Industries, Limited.—Capital £10,000 in 7,500 cumulative participating preference shares of £1 and 50,000 ordinary of 1s. Registered office: 28, Victoria Street, S.W.

Metal Plates, Limited.—Capital £6,000 in £1 shares (3,000 "A" and 3,000 "B"), to adopt an agreement with S. O. Cowper-Coles. Registered office: 1 and 2, Old Pye Street, Westminster, London, S.W.

Harvey, Hiley & Company, Limited, has been registered with a capital of £200 in £1 shares, to carry on the business of ironfounders. The registered office is at 10, Union Passage, Birmingham.

J. & R. Thomson (Castleblair), Limited.—Capital £8,000 in £1 shares, to acquire the business of the Castleblair Engineering Company and J. & R. Thompson & Company. Registered office: Dunfermline.

Everett Refining Process, Limited.—Capital £2,000 in 1,900 6 per cent. cumulative participating preference shares of £1 and 2,000 preferred of 1s. Registered office: 68-70, Fenchurch Street, London, E.C.

(*Continued on page* 772).

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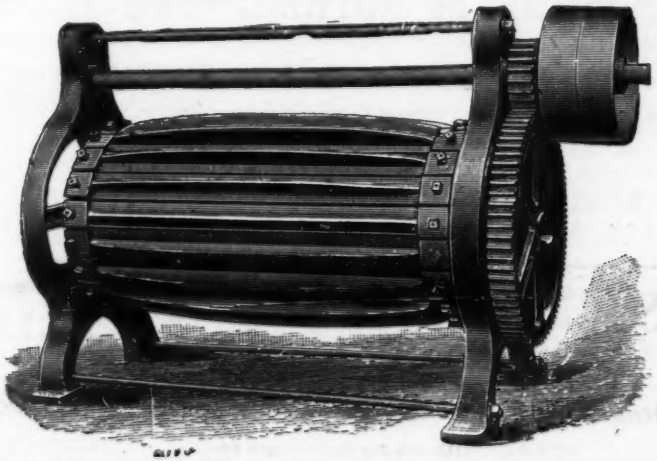

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Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

PEAT-COKE AND OIL SYNDICATE, LIMITED.—Capital £5,000 in 1s. shares, to carry on the business indicated by the title, and to adopt an agreement with J. W. Leadbeater. Registered office: 210, Capel House, New Broad Street, E.C.

JAMES HEAP & SONS, LIMITED.—Capital £2,000 in £1 shares, to carry on the business of ironmasters, steelmakers, wire-drawers, chain and cable makers, etc. The subscribers are Mr. J. Heap, Mr. F. Heap, and Mr. H. Heap, all residing in Heckmondwike.

Armstrong College, Newcastle-on-Tyne.

In connection with the classes in the principles of metallurgy at the Armstrong College, Newcastle-on-Tyne, we understand that students who wish to take both lecture and laboratory courses, and who apply through the British Foundrymen's Association, will be allowed to attend both courses for the reduced fee of £1 5s. The syllabus is as follows:—Nature of combustion; chemical relations of carbon and hydrogen with oxygen and air; measurements of quantities of heat and intensities of heat; Thompson and bomb calorimeters; chief forms of pyrometers; brief outline of composition and properties of natural fuels; manufacture and composition of charcoal and coke; reduction and oxidation; slags, fluxes, and refractory materials; sands for foundry work; construction of furnaces (shaft, reverberatory and crucible furnaces); principal iron ores and their composition; manufacture of cast-iron; conditions influencing composition of the iron; grading of cast-iron; effect of carbon, silicon, manganese, phosphorus and sulphur on properties of cast-iron; segregation and crystallisation. A laboratory course will be held in which the students will conduct experiments and investigations illustrative of this syllabus.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

METALS.	End Nov., 1912.	End Nov., 1911.
Iron—Scotch pig warrants ton	*73/10½	*55/4½
—Middlesbro' warrants ... ton	67/8½	49/7
—W.C. M/nos Bessemer ... ton	86/6	66/6
—Stock, Scotch ... ... ons	1,000	1,000
Copper—Chili bars GMB ton	£76 12 6	£57 11 3
—Stock, Europe and afloat tons	43,552	86,609
Tin—English ingots ... ton	£229 10 0	£170 0 0
—Straits ... ... ton	£226 10 0	£170 5 0
—Stock, London, Holland, U.S.A., and afloat ...tons	—	18,387
Lead—English pig ... ton	£18 7 6	£13 11 3
Spelter—Ord. Silesian ... ton	£26 0 0	£24 0 0
Quicksilver (75lb)... bottle	£7 12 6	£8 0 0
Antimony—Regulus .. ton	£39 0 0 £40 0 0	£28 0 0 £29 0 0
Aluminium—Ingot ... ton	£85 0 0	

*Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	7 7 6	to	7 12 6
Pipes, 1¼ to 2½ in.	6 12 6	to	7 0 0
,, 3 to 4 in.	6 5 0	to	6 7 6
,, 5 to 8 in.	6 0 0	to	6 2 6
,, 10 to 16 in.	6 2 6	to	—
,, 18 to 24 in.	6 2 6	to	—
Chairs	4 14 0	to	4 15 0
Floor plates (open sand)	3 10 0	to	3 12 6

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows: Heavy wrought (mixed), £2 16s. 0d.; light wrought, £1 8s. 0d.; heavy cast, £3 0s. 0d.; all per ton, f.o.b., London. Copper (clean), £69 10s. 0d.; brass (clean), £46 10s. 0d.; lead (usual draft), £17 0s. 0d. Zinc, £21 0s. 0d.; all per ton delivered merchant's yards.

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WORKS— Kelvinvale, Mills, Maryhill, Glasgow;
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also at Middlesbrough and Albion, West Bromwich.

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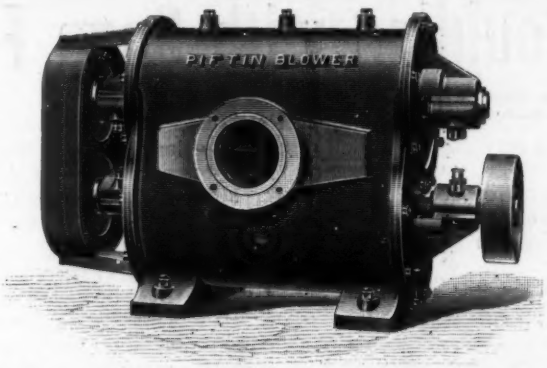
"Cumming, Whittington, Chesterfield."
"Cumming, Blacking Mills, Camelon."



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¶ In our **BOXLESS HYDRAULIC MOULDING MACHINE** we have the snap flask or boxless system combined with a power ramming moulding machine. It is the most complete machine in existence, for it rams both halves of the mould simultaneously, draws the pattern, cuts the runner and gates, closes the mould, and delivers it ready for receiving the metal. ¶ As both halves of the mould are made simultaneously and compressed to an equal extent, much truer and better castings result than when each half is made separately. Correctly located pins and holes in the moulding boxes and pattern frames ensure accurate closing and prevent overshut castings.

¶ The rate of production is such that no man with a plate and a snap flask can possibly compete. 200 moulds a day is quite ordinary and, in some cases, the rate of production with two men amounts to 400 moulds in eight hours.

¶ One firm to whom we have supplied several of these machines is obtaining four times the output they were formerly getting by plate moulding. ¶ Another is getting two and a half times the output, whilst a third is obtaining double the quantity of moulds they were previously getting from pneumatic machines.

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AGRICULTURAL MACHINE FITTINGS LAWN MOWER FITTINGS. ETC., ETC.

The machine will not make any and every casting, but if you will send us sample castings or drawings of your work we will tell you what it will do, or if you would like to see one of our representatives, we will arrange for a visit.

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